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Earvil lab.

INSTRUCTION MANUAL

MODEL 7056

AM/PHASE LOCK GENERATOR

INSTRUCTION MANUAL

MODEL 7056

AM/PHASE LOCK GENERATOR

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EXACT electronics, inc.
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TWX 910-460-8811
A subsidiary of Datalab, Inc.

0107056

SECTION I

SPECIFICATIONS

AND

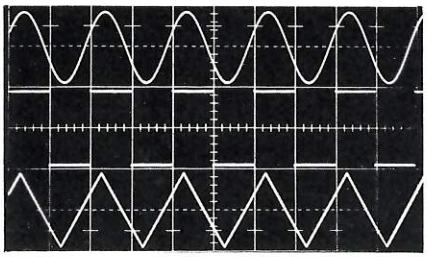
VERIFICATION OF SPECIFICATIONS PROCEDURE

NOTES

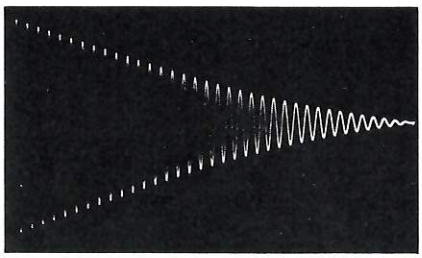
MODEL 7056 AM/PHASE LOCK GENERATOR

FEATURES

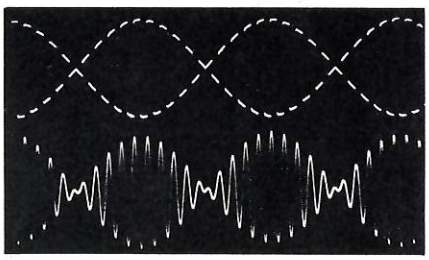
- 0.0001 Hz TO 11 MHz
- VCA VOLTAGE CONTROLLED AMPLITUDE (AM)
- VCF VOLTAGE CONTROLLED FREQUENCY (FM)
- VCP VOLTAGE CONTROLLED PHASE (PM)
- VCO VOLTAGE CONTROLLED OFFSET ±15V
- VCSS VOLTAGE CONTROLLED START/STOP (Triggered and Gated Waveforms)
- INPUTS DIGITALLY PROGRAMMABLE WITH D-A CONVERTERS
- MODULATION PERCENTAGE DOES NOT CHANGE WITH VARIABLE OUTPUT AMPLITUDE
- RELATIVE PHASE ADJUSTABLE THRU 360°
- KELVIN-VARLEY DIVIDER FREQUENCY CONTROL
- SEARCH MODE FOR MANUALLY SWEEPING OVER THREE DECADES
- FLOATING OUTPUT
- 80db ATTENUATION IN 10db STEPS AND 20db VARIABLE
- VARIABLE SYMMETRY RATE TYPICALLY FROM 1:1 TO 19:1
- 30V P-P OPEN CIRCUIT, 15V P-P INTO 50Ω



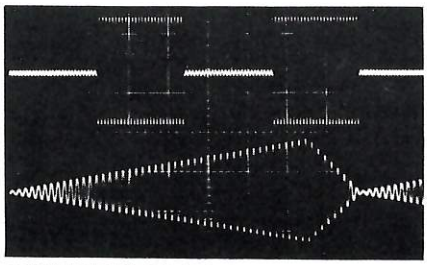
SINE SQUARE TRIANGLE



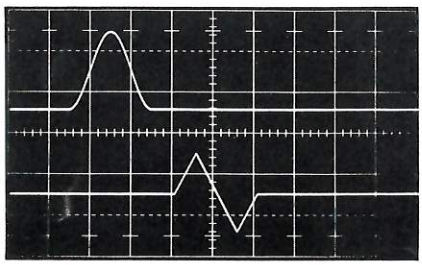
DAMPED SINE WAVE



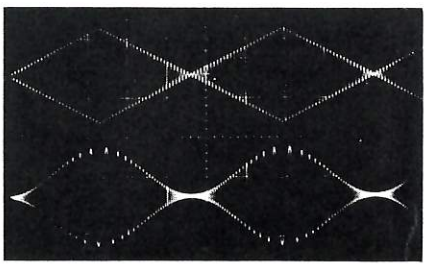
SUPPRESSED SQUARE WAVE CARRIER
SUPPRESSED SINE WAVE CARRIER



SQUARE WAVE MODULATING SIGNAL
RAMP MODULATING SIGNAL



SINE² PULSE
SINGLE SHOT TRIANGLE



TRIANGLE MODULATING SIGNAL
SINE WAVE AM/FM SIGNAL

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GENERAL

he Model 7056 AM/PHASE LOCK generator is a precision source of sine, square, triangle, ramp, pulse and nc waveforms. Amplitude modulation of the generator output is conveniently controlled by the Carrier Level ntrol in conjunction with the modulating waveform to provide 0% to 100% to suppressed carrier amplitude odulation. Modulation percentage does not change with variable output amplitude.

50° phase lock is provided through the range of 10Hz to 11MHz. Indicator lights automatically when gener-or is locked to incoming signal.

ne Model 7056 is capable of being swept or A.C. modulated over a 1000:1 frequency ratio. A search mode provided so that the vernier in the Kelvin-Varley divider frequency multiplier can be used to manually arch or sweep over a 1000:1 (three decades) range within the frequency range selected.

Vaveform symmetry can be adjusted from 1:19 through 19:1 for ramp and pulse operation. Calibration djustments and test points are printed on the top side of the printed circuit board and the calibration rocedure is printed inside the top cover.

rigger and Gate modes are provided allowing single shot and burst operation by application of an external igger or gate or by depressing a front panel push button. The starting and stopping point of the triggered gated waveform is variable through 360 degrees.

xed offset can be selected either positive or negative giving all waveforms the capability of A; having the ost negative excursion at ground, B; having the most positive excursion at ground of C: being symmetrical out ground. ±15V of variable D.C. offset is also available.

ne AM, FM, phase lock, broad frequency range, precision output attenuator, and multiple waveform capabil-y makes the Model 7056 one of the most versatile pieces of test equipment ever offered at its price.

SPECIFICATIONS

AVEFORMS: Sine, Square, Triangle, ± Ramp, ±Pulse, Sync, ±Square, ±Sine, ±Triangle.

YNAMIC FREQUENCY RANGE:
0.0001Hz to 11MHz.

ODES OF OPERATION:
Run-Gate-Trigger, Variable Symmetry, Phase Lock, Amplitude Modulated.

HASE LOCK MODE: Generator phase locks automatically to input fundamental frequency. Relative phase adjustable through 360° with±90° variable and -180° switch selectable through frequency range 10Hz to 11MHz. Also capable of locking to harmonically related signals.

MPLITUDE MODULATION MODE: Main output waveforms can be amplitude modulated or programmed with ±5V max input signal. Carrier Level provides variable signal level control for modulation percentage adjustment, suppressed carrier, and polarity inversion of output signal.

MPLITUDE MODULATION LINEARITY: 2% of full scale.

MPLITUDE SYMMETRY: Waveform symmetrical about ground within ±2% of max p-p amplitude.

'NC OUTPUT:
Square wave approx. 2V p-p open circuit. Approx. 100Ω output impedance.

EQUENCY ACCURACY:
±(1% of setting plus 1% of frequency range) 0.01Hz to 1MHz; ±(2% of setting plus 2% of frequency range). .001 - .01Hz and 1MHz - 10MHz.

AIN OUTPUT: 50Ω output impedance. All waveforms 30V p-p open circuit, 15V p-p into 50Ω with exception of ± fixed offset waveforms which are 15V peak open circuit, 7.5V peak into 50Ω. A full 80db of attenuation is provided in 10db steps with 20db continuously variable.

ATE AND TRIGGER MODES:
Input: DC coupled, input impedance approx. 1K. Trigger signal requirements; manual or external voltage of approx. 100mv for turn on Trigger level adjustable. Approx. 100mv to 15V.

NE WAVE DISTORTION: <0.5% 0.001Hz to 100KHz (typically <0.2%). No harmonics <30db down 100KHz to 10MHz.

RIG INPUT: External connection for gating and triggering generator. Accepts input for phase locking.

'MMETRY CONTROL: Typical range 19:1 continuously variable through 1:1 to 1:19. Generator frequency divided by 10 in this mode.

VCF (voltage controlled frequency) input: Approx. 5V input for 1000:1 (three decades) frequency control.

DC OFFSET INPUT: 1:1 inverting DC offset input allows external analog programming of DC offset. +1V input gives −1V DC offset in output. Step attenuator attenuates output signal and external DC offset equally.

SINE FREQUENCY RESPONSE: 0.1db to 100KHz, 2db to 10MHz.*

SQUARE WAVEFORM: Rise and fall <20nsec. Overshoot and ringing <5%, 500V/μsec slew rate limitation.*

TRIANGLE LINEARITY: 99% to 100KHz, 95% to 10MHz.*

DC OFFSET: Variable ±7.5V into 50Ω, ±15V open circuit. Note: DC offset plus signal cannot exceed maximum voltage output or clipping will occur.

FREQUENCY STABILITY: 0.05% of setting for 10 min., 0.25% of setting for 24 hours.

AMPLITUDE STABILITY: 0.05% of max. p-p amplitude for 10 min., 0.25% of max. p-p amplitude for 24 hours.*

SYMMETRY: (time) ±(1% + 10 nsec)

POWER REQUIREMENTS:
Input Voltage - 115V AC ±10% or 220V AC ±10% (other voltages available).
Frequency - 50 to 60Hz.
Power consumption approx. 50W.

PHYSICAL CHARACTERISTICS:
12½" wide x 3½" high x 13½" deep
Top and bottom covers are easily removable, exposing all calibration and circuit board areas.

PRICE: (f.o.b. Hillsboro, Oregon)

NOTE: (unless otherwise stated). Specifications apply 10% to maximum output voltage, and only at full carrier level, terminated into 50Ω and do not apply in the Search mode.

Specifications are valid at 25° C ±5° C after 1 hr. warm-up time. All stabilities are for constant line voltage and temperature. Prices and specifications subject to change without notice.

* Specs do not apply in AM mode.

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VERIFICATION OF SPECIFICATIONS

It is recommended that the instrument be operated with covers in place for a period of 1 hr. before verification of specifications.

The following test equipment or suitable equivalents of known accuracy are required for complete specification validation for the Model 7056 Waveform Generator.

Oscilloscope, DC to 90MHz, Differential Input with 5mv/cm sensitivity
Tektronix 7704 with 7A13 Plug-in or equivalent.
Counter-Timer, 11MHz to 10,000 seconds
DANA 8010B or equivalent
DVM, .01% accuracy with 1,000 meg ohm floating input
DANA 4300 or equivalent
Harmonic Distortion Analyzer, less than .1% residual distortion
Hewlett-Packard 333 or equivalent
Spectrum Analyzer, 1MHz to 300MHz
Nelson Ross PSA 311 in Tektronix 544 frame or equivalent

Preset all the fron panel controls as follows:

MULTIPLIER - 1.0
RANGE - 1K
SYMMETRY - mid range
FUNCTION - square
AMPLITUDE - mid range
VARIABLE OFFSET - mid range
ATTENUATOR - all sections deactivated
VARIABLE SYMMETRY - deactivated
RUN - depressed or activated
GATE/TRIGGER LEVEL - mid range
GATE/TRIGGER - deactivated
MANUAL - deactivated
PHASE - mid range
PHASE LOCK ON - deactivated
PHASE LOCK-180° - deactivated
AM - deactivated
CARRIER LEVEL - mid range
OFFSET FIXED - deactivated
OFFSET NEG - deactivated
OFFSET VAR - deactivated

FREQUENCY ACCURACY: To measure the frequency accurately all frequency measurements below 1 kilohertz are expressed in period time and all above in hertz. With the counter connected to main output:

Mult. | Range	Actual Setting	Accuracy	Generator should be within
1.0 X .01	.01Hz	±(2% of setting + 2% of Range)	104 Sec. to 96 Sec.
.10 X .01	.001Hz	"	1220 " to 780 "
1.0 X .1	.1Hz	±(1% of setting + 1% of Range)	10.2 " to 9.8 "
.10 X .1	.01Hz	"	111 " to 89 "
1.0 X 1	1.0Hz	"	1.02 " to .98 "
.10 X 1	.10Hz	"	11.1 " to 8.90 "
1.0 X 10	10Hz	"	.102 " to .098 "
.10 X 10	1.0Hz	"	1.11 " to .890 "
1.0 X 100	100Hz	"	10.2ms to 9.80 ms
.10 X 100	10Hz	"	111 ms to 89.0 ms
1.0 X 1K	1KHz	"	1.02 ms to .980 ms
.10 X 1K	100Hz	"	11.1 ms to 8.90 ms
1.0 X 10K	10KHz	"	9.80KHz to 10.2KHz
.10 X 10K	1KHz	"	.890KHz to 1.11KHz
1.0 X 100K	100KHz	"	98.0KHz to 102KHz
.10 X 100K	10KHz	"	8.90KHz to 11.1KHz
1.0 X 1M	1.0MHz	"	.980MHz to 1.02MHz
.10 X 1M	100KHz	"	89.0KHz to 111KHz
1.0 X 10M	10MHz	±(2% of Range + 2% of setting)	9.60MHz to 10.4MHz
.10 X 10M	1MHz	"	.780MHz to 1.22MHz

SINE DISTORTION: Return the Function Selector to Sine Wave and also check to see that generator frequency is set for 1 kilohertz. Amplitude Control should be set for mid range.

1. Connect Distortion Analyzer to the Output Connector terminated into 50Ω. Measure the sine distortion of less than .5% typically .2%.

2. Set the Range to 100K. Measure Sine distortion of less than .5%.

3. Set Range to 10MHz. Connect the Spectrum Analyzer to main output jack and measure the harmonic content. Observe no harmonics less than 30 db down.

SINE FREQUENCY RESPONSE: Set the Range to 10K and connect the oscilloscope to the Output connector.

1. Observe sine wave amplitude.

2. Set Range to 100K. Observe sine amplitude drop less than .1 db.

3. Set Range to 10MHz. Observe sine amplitude drop less than 2 db.

SQUARE WAVEFORM: Set Function Switch to Square. Set Amplitude Control for an output voltage of 10V peak to peak or less into 50Ω. Any voltage greater than this value could yeild a rise time that is slower due to the slewing rate limitations.

1. Observe the rise and fall time to be less than or equal to 20 nanoseconds.

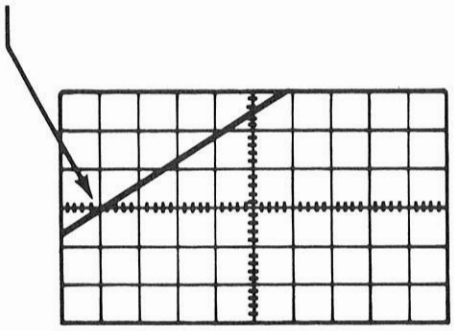
2. Observe that the overshoot and ringing are less than 5% of maximum peak to peak amplitude.

TRIANGLE LINEARITY: Set Range Switch to 1K. Set the Function Selector to Triangle. Monitor the Output Connector with the oscilloscope.

1. Adjust the oscilloscope to obtain 1/2 cycle of the triangular waveform across the full horizontal grid on the oscilloscope CRT.

2. Reset the Differential Plug-in to a sensitivity of 20 millivolts per centimeter.

3. Adjust the comparison voltage until the slope of the triangle waveform intersects the mid-scale horizontal grid line at the second major mark as shown below.



TRIANGLE LINEARITY: (Continued)

4. Record reference voltage using the DVM accurate to I millivolt.

5. Adjust the comparison voltage until slope of triangle intersects next major horizontal grid mark.

6. Record accurately the new reference voltage.

7. Repeat to obtain as many points as desired.

8. Calculate linearity and observe linearity is within specifications.

9. Beware of oscilloscope inadequacies above 10KHz.

FREQUENCY STABILITY: Connect Frequency Counter to main output terminated into 50Ω. Measure frequency accurately. Note the frequency reading. Wait 10 minutes. Measure frequency again and note that frequency change should be less than .05%. Wait 24 hrs. Measure frequency again and note reading remains within .25%.

AMPLITUDE STABILITY: Set amplitude control to maximum. Set DC Offset to Off. Function to Triangle. Connect output of generator to oscilloscope and measure the output, both positive and negative peaks with a 20 millivolt per centimeter sensitivity on the oscilloscope. Measure accurately and record the value of the positive and negative peaks that the triangle produced at the output. Wait 10 minutes and measure positive and negative peaks again and observe the amplitude changes less than 15 millivolts. Wait 24 hrs., measure the positive and negative peaks again and observe the amplitude change is less than 75 millivolts. Note that when measuring the amplitude using the peaks the maximum peak to peak value is the addition of the two peak values.

TIME SYMMETRY: Connect the counter timer to the Sync Output Connector on the front panel. Set the Range to 10K and set the Multiplier to 1.0. Set the Counter Timer to read time interval A to B and B to A. Observe the time symmetry error is less than 1%.

1. Set Range switch to 1K. Observe time symmetry error less than 1%.

2. Set Range to 100. Observe time symmetry error less than 1%.

3. Set Range to 10. Observe time symmetry error less than 1%.

4. Set Range to 1. Observe time symmetry error less than 1%.

SECTION 2

OPERATING INSTRUCTIONS

2.1.0 FRONT PANEL FAMILIARITY (Figure 2.1.1)

1. Power On/Off Switch - turns on input power to instrument.

2. Pilot Lamp - indicates input power is On.

3. Function selector - selects waveform to appear at Output connector.

4. Amplitude Control - Allows 20db continuously variable voltage at Output connector.

5. Var Offset - Allows continuously variable D.C. level of waveforms at the Output connector when activated by Offset Variable 7.

6. Sync Out - Provides square waveform for synchronizing other equipment to Sine, Square, Triangle, or Pulse waveforms.

7. Offset Variable - Activates the Variable D.C. offset control.

8. Offset Fixed - Selects unipolar waveforms at the Output connector. Activating this control maintains the most negative excursion of the waveform at zero volts (within instrument tolerance) and allows continuously variable control of the amplitude. (For Sine, Square, Triangle only).

9. Offset Negative - When activated at the same time as Offset Fixed reverses the action so that the most positive excursion is at zero volts (within tolerance). Note 8 and 9 above for Offset Variable deactivated.

10. Attenuator 10db, 20db, 30db - Allows fixed step attenuation of waveforms appearing at the Output connector. Any combination of the three controls can be activated providing a maximum additive step attenuation of 60db.

11. Output connector - Provides 50Ω output impedance for waveforms selected by the function selector.

12. Multiplier - Provides calibrated fixed steps between range settings. Each step equals 10% of range. The S position places the generator in the search mode of operation. The inner dial allows variable adjustment of frequency between the fixed steps of the outer multipler dial.

13. Range Switch - Selects the desired frequency range.

2.1.0 FRONT PANEL FAMILIARITY (Figure 2.1.1)

14. Symmetry - Provides a continuously variable control of generator time symmetry. This control operates over a range of 19 to 1 while reducing the normal generator frequency to approximately 1/10th indicated frequency.

15. Variable Symmetry - Activates the continuously variable symmetry.

16. Gate/Trig. Level - This continuously variable control allows selection of the voltage at which the trigger input circuitry will be activated providing gated or triggered mode of operation.

17. Run - This control when activated provided a free running waveform as selected by the function selector.

18. Gate - This control when activated provides an external means of controlling when the generator runs in a free running mode or stops. When both the Run and the Gate controls are deactivated then the generator will provide a single cycle of a waveform for each external or manual command signal that is applied.

19. Manual - This control provides a manual means of gating or triggering the generated waveform.

20. Phase - Allows a continuously variable gate or trigger starting point for the sine and triangular waveforms. This control also provides greater than ± 90° phase control in the phase lock mode.

21. Trigger Input - Accepts the input signals necessary for gated, triggered or phase lock modes of operation.

22. Phase Lock Indicator Lamp - Lights when generator is locked to incoming signal.

23. Phase Lock On - Activates internal circuitry providing a variable phase relationship between generator output waveform and an external signal applied to the Trigger Input connector.

24. Phase Lock-180° - Shifts quadrants of the phase lock circuitry so that the full phase lock range of 360° can be selected at the phase control.

2.1.0 FRONT PANEL FAMILIARITY (Figure 2.1.1)

25. A.M. - This switch selects the Amplitude Modulation circuitry so that the output waveform amplitude and polarity may be controlled by an external electrical signal applied to the Ext. Modulation connector.

26. Carrier Level - This control provides a continuously variable output level and polarity in the AM mode from which an external input can start and then increase, decrease or change polarity.

27. Ext. Modulation - This connector accepts the electrical signal for modulating the level and polarity of the output signal.

2.2.0 REAR PANEL FAMILIARITY (Figure 2.2.0)

1. Line Voltage Selector - Allows instrument operation at 117 or 220 volts AC.

2. Fuse Holder - Allows easy replacement in the event of fuse failure.

3. Line Cord - Accepts input power for the instrument.

4. Circuit Common Connection - Allows floating circuit common operation of instrument.

5. Chassis Ground Connection - Provides for grounding of circuit commons.

6. VCSS Input Connector - accepts electrical input signal for varying the Start-Stop level of the triggered or gated waveform or electrical signal for controlling phase in the phase lock mode.

7. DC Offset - Input connector accepts electrical input for externally controlling DC offset of the output waveform.

8. VCF Input Connector - accepts wideband AC or DC input for analog programming of generator frequency.

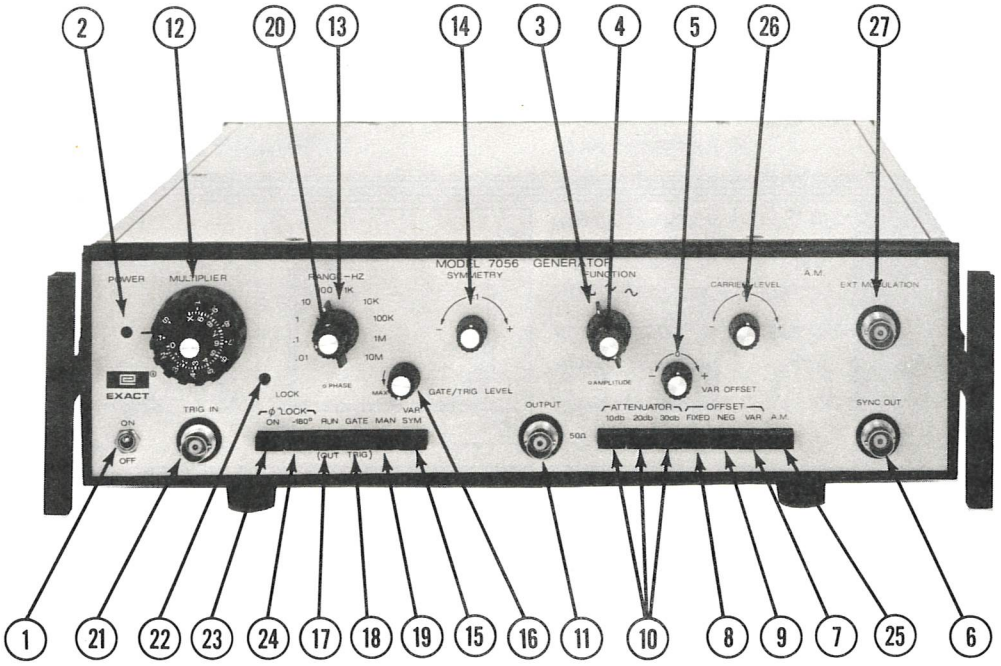


FIGURE 2.1.1 MODEL 7056 (F)
FRONT PANEL FAMILIARITY

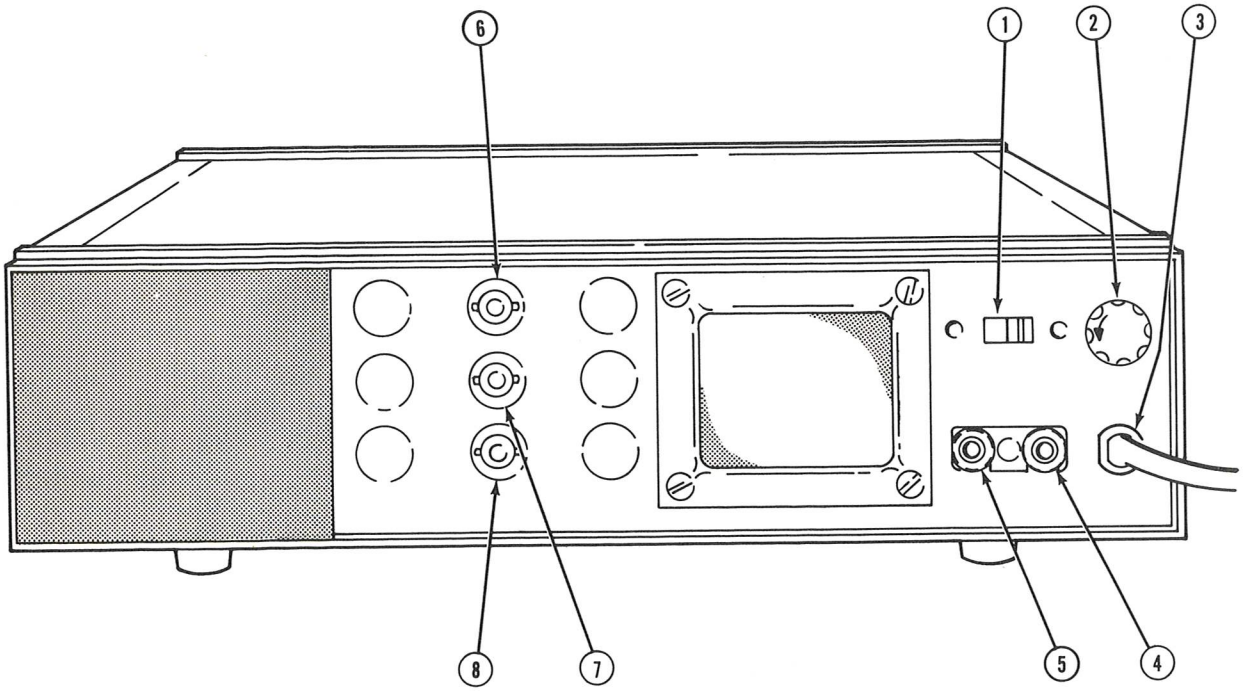


FIGURE 2.2.0 REAR PANEL FAMILIARITY (F)

2.3.0 FIRST TIME OPERATION

NOTE: Before applying power to the instrument the input power line switch must be in the proper position corresponding to the line voltage source which will be applied. The instrument is supplied with the proper fuse for 117 volt operation. If the unit is to be operated from 220 volts AC, place the line switch located on the rear panel to the 220 volt position and change the fuse as indicated by the fuse data silk screened on the rear panel.

NOTE: It is recommended that the rear panel chassis ground and circuit ground connections be connected together with the grounding strap provided unless it is necessary to float the instrument ground.

1. Plug the instrument into source of 117 volt 50 to 60 cycle AC power and turn on Power switch. Preset all front panel controls as follows:

MULTIPLIER	to 1.0
RANGE	to 1K
SYMMETRY	to mid range
FUNCTION	to Triangle
VAR OFFSET	to mid range
VARIABLE SYMMETRY	deactivated (out)
ATTENUATOR	deactivated (all three buttons out)
OFFSET	deactivated (all three buttons out)
AMPLITUDE	maximum clockwise
GATE/TRIGGER LEVEL	to full clockwise
RUN	depressed or activated
GATE	deactivated
MANUAL	deactivated
PHASE	to mid range
PHASE LOCK	deactivated (both buttons out)
AM	deactivated
CARRIER LEVEL	full clockwise

2.3.0 FIRST TIME OPERATION

2. WAVEFORMS
Connect generator outputs throught 50Ω coaxial cable into 50Ω coaxial load and the vertical input of a suitable oscilloscope. The instrument should be providing a 1 kilohertz triangular waveform at approximately 15 volts peak to peak amplitude.

3. FUNCTION
Switch the function selector through its Sine, Triangle and Square waveforms and observe the change in wave shape on the oscilloscope. Return the function selector to Sine wave.

4. AMPLITUDE
Rotate the amplitude control through its range and note that there is a continuously variable control of 20db on the output amplitude of the generator. Return this amplitude control to mid range.

5. FIXED OFFSET
Depress the fixed offset button and note that the waveform reduces in amplitude on the oscilloscope presentation and also note that its most negative excursion is 0 volts. Again rotate the amplitude control through its range and note that the most negative excursion under any condition is 0 volts for the selected waveform. Next depress the negative offset button while leaving the fixed offset button depressed. Note that the waveforms most positive excursion now is 0 volts and as you rotate the variable amplitude control this condition remains the same. Note that both fixed and negative offset buttons must be depressed to activate this mode. Deactivate both the fixed and negative offset buttons and return the variable amplitude control to mid range.

6. VARIABLE OFFSET
Depress the variable offset button and rotate the DC offset control and note that the DC level of the waveform is now adjustable. Note maximum output signal levels must not be exceeded when utilizing both maximum amplitude and any amount of DC offset. Deactivate the variable offset button and return the amplitude control to mid range.

7. EXTERNAL OFFSET
Using a low impedance variable voltage source apply a small voltage to the external offset input and note that for each positive volt of input there is a matching negative volt of output from the generator. Again noting that maximum output cannot exceed the maximum output level of the generator. Also note that for each negative volt of external offset applied there is a positive volt on the output thus verifying the relationship as a 1 to 1 inverting configuration. Remove the external supply and return the variable amplitude control to maximum clockwise.

8. ATTENUATOR
Depress the 10db attenuator and note that the output amplitude reduces to approximately 1/3 of its original level. Deactivate the 10db attenuator and then depress the 20db attenuator and note that the output amplitude drops to approximately 1/10th its original level. Deactivate the 20db attenuator and depress the 30db attenuator and note that the output amplitude is reduced to approximately 1/30th the original amplitude. Leaving the 30db attenuator activated depress the 10db attenuator and note that the overall attenuation then adds to be 40db and so forth and so on until a maximum of 60db attenuation is attainable through the push button attenuation. Note also that these attenuators attenuate the DC offset in the same porportion as the output amplitude. Return all attenuator buttons to a deactivated state.

2.3.0 FIRST TIME OPERATION

9. VARIABLE SYMMETRY

Depress the variable symmetry button and note that the generator frequency reduces to approximately 1/10th of the original frequency. Rotate the variable symmetry control and note that the time symmetry of the waveform can be shifted from a 19 to 1 and then 1 to 19 ratio. This control may best be utilized in the triangle or square function and in these cases either a ramp/negative ramp or a pulse/negative pulse is produced. Deactivate the variable symmetry control and return the function selector to sine wave.

10. RUN GATE TRIGGER

Connect an external oscillator signal of approximately 5 volts peak to peak and approximately 100Hz in frequency to the trigger input connector. Deactivate the Run Button and note that the generator output now is a single cycle of waveform for each cycle of the external 100Hz oscillator. Rotate the Gate Trigger level and note that the generator can be made to trigger at a variable external voltage. Rotate the Phase Control and notice that the starting point or lockout level of the waveform is continuously variable over 1/2 of a cycle. As the Phase Control is advanced beyond 90° in either direction the waveform may distort or free run. By utilization of the AM capability an inverted signal can provide starting points along the other half cycle. See AM operation. Depress the Gate button and note now that the generator no longer provides a single cycle for each externally applied signal but continues to provide output cycles as long as the external signal is greater than the Gate Trigger level. The generator will always complete its cycle and return to the start-stop level. Note that the Gate Trigger level will vary the number of cycles provided, generating a Burst mode of operation. Remove the external oscillator signal and depress the Manual button. Note that this button gates or triggers the generator the same as the application of an external signal.

11. MULTIPLIER AND FREQUENCY RANGES

Return the Multiplier dial to a setting of 1.0. Note that the frequency then is 1.0 times the range setting of 1K or 1KHz. Turn the inner dial of the Multiplier to X and note that the generator frequency then has increased to 10% over the 1KHz or 1.1KHz. Return the inner dial to 0. Turn the outer dial to .9 and note than that the generator frequency is .9 times 1K or 900Hz. Turn the inner dial up from 0 to X and note then that the frequency of the generator can be changed from 900 to 910, 920, 930 etc. on up to 1,000Hz again. Return

2.3.0 FIRST TIME OPERATION

11. MULTIPLIER AND FREQUENCY RANGES (Continued)
the inner dial to 0. Turn the outer dial through each of its steps and note the generator frequency can be continuously varied from an overrange of 1.1 down to .1 times the range frequency setting, or in other words from 100Hz to 1KHz. Rotate the outer dial to the position marked S and note then that the inner dial will cause the generator frequency to be varied from a maximum of the 10% overrange or 1.1 times 1KHz down to 1/1000th of the 1KHz or approximately 1Hz. This is the search mode of operation providing the continuously variable 1000 to 1 range. Reset the inner dial to 0.

12. VCF
Connect an external DC voltage supply to the VCF input connector and note then that as the generator is at 1Hz from the previous step above the generator frequency can be increased by applying the 0 to 5 volts to the VCF input connector. Rotate the search control to X and apply a negative 0 to 5 volts to the VCF input connector and note that the frequency can be reduced from 1.1KHz down to the lower frequency of 1Hz by applying negative 5 volts. Note that in no case should the generator frequency be increased beyond the 1.1 times the range setting, nor should it be lowered below 1Hz or 1/1000th of main dial. Return Multiplier to 1.0.

13. PHASE LOCK
Connect an external oscillator of approximately 5V peak to peak and approx. 800Hz to the trigger input connector. Depress the Phase Lock On button and then rotate the Multiplier dial towards .80. As you reach within a few percent of the externally applied frequency the Lock light should light and the generator will be locked. As a great deal of range is provided in the phase control it may be necessary to rotate it toward the center of its range to reach lock. Once lock is achieved compare input and output frequencies on the oscilloscope and note that the relative phase is adjustable through use of the phase control. Depress the -180° button and note that variable phase control covers ± 90° in the other quadrant for a total of 360°. Release Phase Lock On and -180° button.

14. AM
Depress the AM button and the Run button and note the output waveform amplitude and polarity can be controlled by rotation of the Carrier Level control. The carrier level sets a starting point and then any external modulation voltage can vary amplitude or polarity from this quiescent starting point. The normal amplitude control of the generator also controls the output level of the waveform processed through the amplitude modulation circuitry.

SECTION 3

CIRCUIT DESCRIPTION

3.1.0 BLOCK DIAGRAM (Figure 3.1.1)

The basic generator loop utilized in this waveform generator consists of a pair of current sources alternately charging and discharging a timing capacitor. The triangular waveform generated in this timing capacitor is applied to a high input impedance triangle buffer amplifier which then applies the triangular signal to the bi-stable level detector. The output of this level detector is then fed back to alternately switch the current sources thus the loop is closed forming a free running generator. The level detector is used to switch the current sources at a predetermined point on the triangle thereby generating a constant amplitude triangle regardless of frequency of operation. Having generated a triangle of constant amplitude the frequency then is porportional to the timing capacitance and the current supplied to the capacitor from the constant current sources. Decade values of frequency are selected by decade selection of the timing capacitors and decade selection of the constant current sources. Variable frequency adjustment is accomplished by variable adjustment of the current sources through application of a DC voltage. For alternately charging and discharging the range capacitors one constant current source is a positive source and the other is a negative. In order that these can be externally controlled with a single DC voltage a pair of level shifting amplifiers are supplied that convert a single input voltage to the voltages necessary to drive the positive and negative current sources. The positive and negative level shifting amplifiers are driven by the single VCF amplifier that can accept a signal either from the generator Multiplier dial or from an external DC voltage. The Multiplier dial receives its signal from a constant voltage amplifier called the Frequency supply.

This basic generator loop by nature provides a triangular waveform and a square waveform that can be processed and used as output signals to provide two waveforms. The triangular waveform can be processed through the sine converter to provide a sinusoidal waveform. The triangular waveform available at the output of the triangle buffer can be applied directly to the preamp through the function switching network. This then provides the triangular output waveform. The square waveform from the level detection network is applied directly to the square amplifier which then goes directly to the preamplifier. The square amplifier by nature can accept a DC signal from the function switching network to either activate or deactivate its operation. For sinusoidal operation the triangular waveform from the triangle buffer is supplied through the function switching network to the sine converter. The output of the sine converter is then fed to a sine amplifier which boosts the operating voltage level of the waveform, This waveform is then applied back through the function switching network to the preamplifier. The preamplifier utilized in this generator is used to boost the operating signal levels generated by the basic generator loop to something suitable for processing in the power amplifier. The preamp is also used to provide the offset functions which decrease the amplitude of the generated waveform to one-half and offset it to a value that maintains one peak at 0 volts. The output of this preamp is applied directly to the amplitude potentiometer which selects the amplitude applied to the power amplifier or it is processed through the AM circuitry and AM logic for external amplitude control and then applied to the amplitude potentiometer. The power amplifier can accept not only this amplitude signal but offset signals from the external

3.1.0 BLOCK DIAGRAM (Figure 3.1.1) Cont'd

input or the variable offset control. The output of the power amplifier is directly applied to the step attenuator which can attenuate the signal in fixed db steps. Output of the attenuator is the main output connector for the generator. There are six power supplies in this generator, two of them being the unregulated raw supplies available directly at the filter capacitors. This voltage is a nominal 31 volts which is stepped down through the positive regulators for a plus 24 volt supply and a minus 24 volt supply. The plus and minus 24 volt supplies are used to provide voltage for the constant current sources as well as for the power amplifier. The plus and minus 24 volt supplies are re-regulated through the plus and minus 15 volt regulators to provide all the operating potentials necessary for operation of the other circuitry.

3.1.0 BLOCK DIAGRAM (Continued)

The power supply regulating system that supplies a plus 3.2 and a minus 2.0 volts in reference to ground is used to operate the trigger amplifier, trigger comparators and run gate logic systems.

In order to lockout the main generator loop the application of the positive current source for charging the timing capacitor is interrupted through the use of switching diodes and a lockout current source. The lockout current source is used to sink the timing current available from the positive current source and clamp the timing capacitor voltage to the phase supply voltage. The negative lockout current source derives its tracking signal from the lockout level shifting amplifier. The lockout level shifting amplifier receives its input from the positive level shifting amplifier used in the positive current source in the main generator loop. Operation in this manner allows the lockout current source to operate at a current that tracks at two time the current applied by the positive generator current source. A lockout flip-flop is used so that the application of the lockout current source only occurs at the proper time and the generator loop will then always complete its last cycle of operation regardless of when a gate or run command is removed. The lockout flip-flop is buffered through the use of lockout driver amplifiers which are applied directly to the diode switches. The operation of this flip-flop is arranged such that any input or set signal will over-ride the reset signal and a continuous application of the set signal will yield a continuous output, that is, the generator will run continuously. In order that both single cycle and a gated mode of operation can be realized a gate trigger logic selects whether the run command can be coupled through in a DC form or AC coupled such that a single pulse is provided for each input command. The main run command over-rides all others and provides for free running operation through the activation of this flip-flop. A trigger amplifier and trigger comparator is used to condition the external input signals for gated and triggered modes of operation. The trigger comparator circuit is wired as a Schmitt trigger with appropriate feedback such that a reasonable amount of hysteresis is gained. This hysteresis affords reliable triggering for both single shot and gated operation. The trigger amplifier increases the gain of the trigger channel such that a very low signal level of approximately 100 millivolts will trigger the Schmitt and a variable level control can increase this level to approximately 15 volts creating a very wide dynamic range of external input capability. The manual trigger button will also apply the DC voltage necessary at the trigger amplifier to set the trigger comparator amplifier reliably.

The phase lock logic applies the proper potentials to the lockout switching diodes so that any lockout of the generator is defeated and a signal from the phase lock amplifier is applied to the input of the VCF amplifier. The phase lock amplifier receives a signal form the lockout driver amplifier that is porportional to the difference between

3.1.0 BLOCK DIAGRAM (Continued)

phases of the main generator loop and an externally applied trigger signal. The Phase LockAmplifier is connected to integrating capacitors through the normal Frequency Range switch. This amplifier then applies the integrated phase difference signal to the phase lock logic which then applies the signal to the VCF amplifier. The lamp driver accepts also the output signal of the phase lock amplifier and determines when the phase lock amplifier is within its proper operating range or a lock has occured. The normal or -180° logic selects the reset signal available from the main generator loop level detector in either polarity that will be applied to reset the lockout flip-flop. This reset signal then being available in either of two phases creates a phase information at the output of the lockout drivers that also is available in either of two phases.

3.2.0 CIRCUIT DESCRIPTION

3.2.1 POWER SUPPLY (Figure 6.2.1)

The primary power for this instrument is supplied through the line cord to fuse F-100 which is selected for each voltage of operation. The primary power is then applied through the main power switch S-100 to the transformer primary and line voltage switch S-101A. The Line Voltage switch S-101 selects the method of connection for the primary taps so that a selection is available as to which line voltage the instrument will operate at. Transformer T-100 steps down the operating potentials of the input primary power so that the proper voltage is developed through the usage of diode bridge D-120A and filter capacitors C-120 and C-140. This full wave center tapped bridge rectifier setup provides both positive and negative operating potentials of sufficient magnitude to be regulated through the usage of the plus and minus 24 volt regulators. Integrated circuit Q-120 is a self contained voltage reference and error amplifier. The output of this error amplifier is fed to series pass transistor Q-125 which enhances the current carrying capability of Q-120. Resistor R-125 is a current sensing resistor that allows Q-120 to reduce the output voltage of the supply in the event the current reaches a predetermined value. The voltage feedback, necessary for the error amplifier, is derived through the usage of the voltage divider R-126 through R-128. The potentiometer R-127 provides for a vernier adjustment in the power supply voltage. Diode D-125 is used to prevent accidental application of negative voltage to the positive regulator. Application of negative voltage would damage the integrated circuit. Capacitor C-125 prevents the build up of transient voltage at the output of the supply under varying load conditions. The instrument power indicator I-100 is operated from the regulated 24 volt supply. The positive 24 volt supply is applied to a combination of Q-130 and Q-135 so that it can be re-regulated to provide a source of plus 15 volts. Integrated circuit Q-130 contains its own internal reference voltage and error amplifier so that when used in conjunction with series pass transistor Q-135 a precision source of power supply voltage is available. Resistor R-135 provides a current sensing voltage so that current limiting can be provided at a predetermined value. The voltage feedback signal necessary for closed loop operation is provided by resistive divider R-136 through R-138. Potentiometer R-137 provides for vernier adjustment in the value of the output voltage of the regulator. Diode D-135 prevents damage in the event of accidental application of a negative voltage to this positive regulating system. Capacitor C-135 prevents a voltage buildup due to transient loading on the output of the power supply. Transistors Q-140 through Q-160 provide a regulation of the negative raw voltage such that a minus 24 volts is produced. This regulator utilizes the positive 24 volt supply as a reference. Resistor R-156 through R-158 forms a voltage divider between the positive 24 volts and the negative 24 volts supply. The adjustable potentiometer provides a calibration adjustment for the -24 volt supply. A differential pair Q-150 and Q-155 then amplifies the difference between the voltage developed at the swinger of the potentiometer and a reference provided through resistor R-150. The Output signal then from this difference is applied to transistor Q-140 through R-141. Transistor Q-140 is phase compensated through capacitor C-141 and R-142 and its output then is applied through R-145 to the base of the series pass transistor Q-145.

3.2.1 POWER SUPPLY (Continued)

Resistor R-146 senses the current output of the supply by providi ng a voltage porportional to current that is applied to the base-emitter junction of transistor Q-160. Upon reaching the predetermined current limit, transistor Q-160 begins drawing current through diode D-160 and resistor R-161 upsetting the balance of the differential pair Q-150 and Q-155 so that output voltage is reduced. Capacitor C-160 prevents a voltage build up due to transient loading on the output of the power supply. Diode D-161 prevents accidental damage in the event of application of a reverse bias voltage to this supply. The negative 24 volts from this regulator then is supplied to the negative 15V regulator made up of transistors Q-165 through Q-180. Integrated circuit Q-165 is an operational amplifier whose input is derived from the resistive divider R-165 through R-167. The output of this voltage di vider is the difference between the positive 15 volt supply and the negative 15 volt supply. When these two supplies are equal and opposite the error voltage supplied to the operational amplifier Q-165 is zero and the supply is at rest or in a quiescent condition. The output of the operational amplifier Q-165 is fed through a level shifting diode D-165 to the bias and stablizing resistors R-170 and R-171. It is then applied to the base of transistor Q-170 operated as an emitter follower whose output is directly applied to the series pass transistor Q-175. Transistor Q-175 is operated as a series pass emitter follower transistor such that the operating current level of this supply can be supplied. Resistor R-175 provides a voltage porportional to current such that transistor Q-180 can be biased on at a predetermined current level. When this current level is reached Transistor Q-180 begins drawing current from the input of the operational amplifier Q-165. This current drawn from the input lowers the output voltage so that the output in effect will be current limited. Capacitor C-175 and C-176 prevent voltage build up at the output of the supply in the presence of varying loads on the supply. Diode D-175 prevents the application of reverse biasing potentials to the regulator that could result in damage.

3.2.2 LOGIC POWER SUPPLY (Figure 6.2.2)

The secondary winding of Transformer T-100 terminated in pins 8, 9 and 10 provides a voltage when rectified by Diodes D-100 and D-105 that is regulated to provide the plus 3.2 and minus 2.0 volt supply. The filter Capacitor C-101 is used to provide a ripple-free raw supply voltage to the integrated circuit regulator Q-100. Integrated circuit Q-100 contains an internal reference voltage as well as an error amplifier that is wired together with the external series pass transistor such that it maintains the difference between the input and output voltage at 5.2 volts. Voltage divider R-100, R-101 and R-102 provides the necessary adjustment in output voltage to maintain the proper operating level. Capacitor C-102 is a phase compensating network for the integrated circuit Q-100. Resistor R-105 is a current sensing resistor that allows the current limiting function of Q-100 to operate. Capacitor C-105 prevents the voltage build up due to varying load conditions on the supply. Diode D-106 prevents damage to the regulator in event of application of reverse biasing potentials. The nominal differential of the 5.2 volts provided by the regulator and series pass transistor is applied to the transistor network Q-515. This network together with bias resistors R-507, 508 and 519 maintains the plus 3.2 volts and minus 2.0 volts in reference to the instrument common. Capacitor C-516 filters out ripple due to varying loads that are unbalanced. Transistor Q-430 along with its voltage divider and biasing resistors R-430 through R-433 is used as a buffered supply of negative 4 volts. This supply is derived directly from the negative 15 volt regulated supply.

3.2.3 FREQUENCY CONTROL CIRCUITRY (Figure 6.3.1)

The frequency supply is a closed loop buffered operational amplifier system that provides a voltage for the multiplier dial. Operational amplifier Q-300 receives its input signal from R-304. R-306 is the feedback resistor that provides the necessary closed loop voltage gain. Transistor Q-310 is operated as an emitter follower to boost the current carrying capability of the frequency supply. The output of this frequency supply is applied directly to the rotary switch wired up as a Kelvin-Varley divider. This Kelvin-Varley divider has an extra position that allows the vernier potentiometer to span the full output voltage capability of the frequency supply. The output then of this Kelvin-Varley divider used as a frequency multiplier is applied through a summing resistor to the VCF amplifier. The VCF amplifier is capable of accepting a signal from the external VCF input or from the Multiplier dial. Integrated circuit Q-240 is an operational amplifier with an emitter follower buffer transistor Q-235. Q-235 enhances the current carrying capability of the VCF amplifier. Potentiometer R-243, the search range adjustment, injects a small current to the input of the VCF amplifier so that under normal operating conditions of the Multiplier dial, zero frequency can never be obtained and the maximum range of 1/1000th of the dial frequency is obtained. Potentiometer R-246, the VCF balance control, compensates for the offset voltage of the amplifier Q-240. Resistors R-235 and R-237 provide the proper operating biases for the emitter follower transistor Q-235, and R-238 provides for a vernier adjustment of VCF amplifier gain or Frequency Adjust. The output of the VCF amplifier at the emitter of Q-235 is applied directly to the non-inverting input of the operational amplifier Q-275. It is also processed through frequency control connection schematic 2A for application to the input resistor R-269A. The output voltage at the output of the VCF amplifier is a nominal negative 5 millivolts to negative 5 volts for a frequency range of 1000 to 1. The most negative voltage being the highest frequency.

The level shift amplifiers are in reality voltage variable current sources whose outputs are taken from a pair of matched precision resistors referenced to equal and opposite power supplies. One level shift amplifier being driven from the negative input or inverting input and the other being driven in the non-inverting input provides equal and opposite polarities of output voltages suitable for driving the main current sources in the generator loop. The signal return path for R-269B at the input of Q-275 is routed through the frequency control connection schematic 2A. The current balance potentiometers R-265 and R-275 are utilized to balance out the internal offset voltage of the operational amplifiers Q-265 and Q-275. The field effect transistors Q-270 and 280 are used to buffer the output of the level shifting amplifiers in such a manner that the leakage currents are very small and output impedance is very high.

3.2.4 VARIABLE SYMMETRY (Figure 6.3.2)

Having noted from schematic 2, Frequency Control Circuitry, that resistors R-269A and B a matched pair, are the input and gain setting resistors for the level shifting amplifiers it can be shown then that with the activation of the Symmetry switch, S-265, a variable potentiometer can be added to this input resistance for a variable symmetry network. The potentiometers are connected such that when the potentiometer is in the center the resistance in R-268A is the same as R-268B. They are also wired such that as you turn the symmetry control the resistance increases in one potentiometer and decreases in the other. This increase in resistance in one level shifting amplifier input resistor and decrease in resistance in the other unbalances the output of the level shifting amplifier in direct porportion to the rotation of the variable symmetry dial creating and unbalance in the charging and discharging current in the main generator loop thereby creating a continuously variable control over the symmetry of the triangular waveform that is generated.

3.2.5 GENERATOR LOOP CIRCUITRY (Figure 6.4.1)

The positive and negative current sources receive their equal and opposite driving voltages from the level shifting amplifiers in schematic 2. The positive and negative current sources are operational amplifiers whose inputs are buffered with dual field effect transistors and whose output is taken from a single field effect transistor. The input signal at the gate of the dual field effect transistor Q-400 is applied to the positive input of the operational amplifier Q-405. The output of the operational amplifier Q-405 is applied to the gate of the field effect transistor Q-410 and as far as the closed loop amplifier is concerned the field effect transistor is operated as a source follower. The negative feedback for closed loop operation is from the source connection of the field effect transistor back to the gate input connection of the dual field effect transistor Q-400. The output of this source follower then is taken from R-403 center tap and applied to the negative input of the operational amplifier Q-405. The effective input resistor then to this closed loop amplifier is the set of range resistors R-405 through 409A. The input voltage to this current source varies between approximately plus 15 to plus 10 volts. Therefore, being operated as a closed loop amplifier the voltage at tp400 will remain the same as the input voltage and the current flowing through the range resistors will be controlled by the input voltage. The nature of a field effect transistor is such that the source current is very nearly equal to the drain current and thus the current flowing from the drain connection is controlled by the closed loop amplifying system. The negative current source comprised of Q-415, Q-420 and Q-425 operates in the same manner except that it is referenced instead to the negative 15 volt supply at the range resistors. The input voltage varies from negative 10 to negative 15 volts. The power supply connections for the operating potentials of the dual field effect input transistors and the operational amplifiers are derived from the plus and minus 24 volts available from the regulators. The value of current then supplied by these current sources to the timing capacitors is controlled by the input to the VCF amplifier and the range resistors. The positive and negative currents from the current sources are continually applied to the switching bridge which then allows the level detector square wave signal to apply alternately either one or the other of the current sources to the timing capacitor. The range switch selects a matched set of capacitors for different decade ranges of frequency operation. The triangular voltage developed across the timing capacitor is applied to a triangle buffer amplifier through filter R-435 and C-435. The triangle buffer amplifier is comprised of a very high input impedance source follower whose output is applied to two stages of emitter followers. Q-435A, Q-440A and Q-445A are these transistors. The operating bias potential for these transistors to operate with a zero offset from output to input is supplied by the matched counterpart to each device thus Q-435B, Q-440B and Q-445B. The field effect transistor Q-435B is operated at a gate source potential equal to the base emitter drops of the two transistors Q-440B and Q-445B. This field effect transistor then forces Q-435A, another field effect transistor, to operate at the same drain current thereby requiring the same gate to source potential. This potential being equal to the two transistor drops then realizes a zero output voltage from the input at C-435 to the output at tp456. Q-445A then being an emitter follower provides a low output impedance source of

3.2.5 GENERATOR LOOP CIRCUITRY (Continued)

triangular voltage to be applied to the level detector and to the function switching networks for processing in the output amplifiers and etc. The level detector consists of transistors Q-460 through Q-475. This detector receives its input through the compensated voltage divider consisting of R-458 and R-459. Capacitors C-455, 456 and 457 provide a high frequency lead network that compensates for the high frequency responses of the level detector network. Transistor Q-456 is a constant current source providing the operating currents for differential pair Q-460A and B. This differential pair of transistors is used to compare the triangular voltage developed at the divider network to the square wave voltage developed at resistor R-460. The square wave voltage developed at resistor R-460 is generated through the use of adjustable current supplies switched in through the use of the diode switching bridge network D-460 through D-463. The output of the differential input pair is applied to another differential pair, transistors Q-470 and Q-475. Diodes D470 and D-471 clamp the collector voltages so that a small differential voltage can exist between the two. This maintains a current mode of operation enhancing high speed operation. The collector of transistor Q-475 and its load resistor R-468 provides a square wave that is clamped in amplitude by the limiting bridge diodes D-464, 465, etc. This square wave voltage is applied to the reference switching bridge D-460 through D-463 providing the positive feedback necessary for a bi-stable operation. The square wave output from the level detector is also fed to the sync output buffer through diodes D-481 and D-482. It is also applied to the switching bridge that selects either the positivie or negative current source for the timing capacitors and the square amplifier that generates the square waveform that is applied to the pre-amplifier.

3.2.6 OUTPUT CONDITIONING CIRCUITRY (Figure 6.5.1)

The sine converter network receives its signal from the function selector only when a sine waveform is selected. The input level to this sine converting network is adjusted through potentiometer R-624 and the other associated resistors. The triangular input voltage is applied to all four of the diode switching bridges simultaneously, and the output of these bridges is summed together in a single resistor R-618. Various resistors such as R-617, R-620 and R-637 are used to provide voltage breaking points that allow the currents to be changed in successive addition as the input voltage to the sine converting network goes from zero volts to say a positive or negative voltage. The sine waveform then appearing at the output summing resistor R-618 is applied to the input of the sine amplifier at Q-830A. Capacitor C-831 removes the high frequency components of the waveform before processing in the sine amplifier. The sine amplifier is a closed loop amplifier whose positive or non-inverting input is the base of Q-830A. Q-830A and 830B is a differential amplifier whose output is applied in Cascode form to transistor Q-835. The base of transistor Q-835 is elevated to a bias suitable for the maximum output voltage by diodes D-838 and temperature compensating diode D-837. The output

3.2.6 OUTPUT CONDITIONING CIRCUITRY (Continued)

of this stage is applied through two biased diodes D-835 and D-836 to the compound emitter followers Q-840 and Q-845. The negative feedback necessary for closed loop operation is provided by resistor R-846 to the effective input resistor R-847. Also paralleling R-847 is a vernier adjustment sine gain potentiometer R-836 and its limiting resistor R-837. The output of this sine amplifier is applied directly back to the function switching network through R-842. The square signal from the level detector in the main generator loop is applied to the current mode switch called a square amplifier through level shifting diode D-862. Transistors Q-860 and Q-850 are the current mode switch whose inactive input at the base of Q-850 is controlled by the combination of the Diodes D-850, 857 and the level adjusting potentiometer R-854. Adjusting the square gain potentiometer R-854 varies the base bias at the base of transistor Q-850 therefor varying its emitter bias through R-860 varying the level of the square output voltage. The collector load resistor for this output stage is R-855 and 856. R-855 being the square DC adjust potentiometer. Diode D-855 is a disconnect diode which allows the square amplifier to be deactivated by an external DC control signal available from the function switching network. This DC control signal is also applied to the base bias of Q-850 deactivating its operation when the square signal is not required. The output of this square amplifier is applied directly to the input of the pre-amplifier through R-608. The pre-amplifier then accepts signals through R-608 from the square amplifier when it is activated or from the function switching network through R-607. The pre-amplifier is a closed loop amplifier whose gain setting feedback resistor is R-757. This amplifier is a high performance amplifier with two signal paths, one containing the path for lower frequencies from DC to approximately 100 kilohertz and the other path for frequencies above 100 kilohertz. The feedback resistor R-757 is paralleled with a resistor of the same value R-758 for the fixed offset function. This reduces the gain of the amplifier by one-half and applies the fixed offset potential through R-708 and R-709.

The high frequency portion of this amplifier is comprised of two sets of Cascode amplifiers, that is, one set being Q-720 and Q-730 referenced to the plus 15 volts supply and the other being Q-725 and Q-735 referenced to the minus 15 volt supply. The outputs of these two Cascode amplifiers are connected together through bias diodes D-740 through D-746. The bias diodes provide the necessary quiescent operating bias for the input emitter followers Q-740 and Q-745. The summing junction or actual input connection to the amplifier is at the junction of the two high frequency input capacitors C-715 and C-725. The output of the input emitter followers Q-740 and Q-745 is applied to the output emitter followers through the bias diodes D-742 and D-747. Transistors Q-750 and Q-755 provide the necessary output current carrying capability through degeneration resistors R-750 and R-755. The Cascode stage comprised of Q-720 and Q-730 is operated as a slightly higher quiescent current than the opposite Cascode amplifier Q-725 and Q-735. This slightly higher current allows transistor Q-700D to be biased on at a quiescent potential thereby allowing a point to inject the signals from the low frequency or DC channel in the amplifier. The input connection to the amplifier applies the low frequency or DC signals through resistor R-701 to the base

3.2.6 OUTPUT CONDITIONING CIRCUITRY (Continued)

of differential transistor Q-700A. The differential output available from transistor Q-700 at the collectors and R-703 and R-704 is applied directly to another differential pair made up of transistors Q-700C and Q-700D. The single ended output from transistor Q-700D is applied directly through resistor R-715 to the Cascode amplifier Q-720 and Q-730. Potentiometer R-707, named the triangle DC adjust, compensates for variations in the offset of the differential amplifier Q-700.

The signals available from the output of the preamplifier are applied to the input of the AM circuitry and also to the AM/Normal logic. The AM/Normal Logic selects whether the preamplifier signals are applied directly to the amplitude potentiometer or first through the AM circuitry and then to the amplitude potentiometer. This potentiometer and its bottoming resistor R859 provide a vernier control of the output amplitude of the generator. These signals are applied directly through gain controlling potentiometer R849 and amplitude setting resistor R850 to the input of the closed loop output amplifier. The variable DC Offset at potentiometer R853 can also be applied through its switch S837 to a gain setting resistor R852 and to the input of the amplifier. Resistor R848 provides a point for externally injecting a DC Offset signal to the closed loop output amplifier.

The output amplifier is very similar to the pre-amplifier. This output amplifier has two signal paths for processing the input signals. One for low frequency signals from DC to approximately 100 kilohertz and the other for frequencies of approximately 100 kilohertz and above. The higher frequency signal path flows from the input connection through capacitors C-780 and C-785 to the bases of the two Cascode amplifiers. One amplifier being transistors Q-780 and Q-790 and the other being transistors Q-785 and Q-795. The signals are simultaneously applied to both amplifiers and the output then of these amplifiers are connected together and applied to the output emitter followers. Diodes D-800 through D-806 are bias diodes for generating a quiescent current for the input emitter follower stages Q-800 through Q-805. Bias diodes D-802 and D-807 provide a quiescent bias for the output transistors mounted to the heat sink Q-810 and Q-815. Degeneration resistors R-810 and R-815 applies the signal directly to the gain setting feedback resistor R-817 and the output impedance resistors R-820 through R-822. The Cascode amplifier referenced to the positive supply Q-780 and Q-790 is operated at a slightly higher current than the Cascode amplifier referenced to the negative supply. This higher current allows a small bias current to be drawn through R-775 by the differential amplifier Q-760C and Q-760D. This connection allows injection of the DC and low frequency signals to be processed through the amplifier. The low frequency input signals are coupled from the input connection through resistor R-761 to the base of the differential amplifier Q-760A. The differential

3.2.6 OUTPUT CONDITIONING CIRCUITRY (Continued)

output from this amplifier from its collectors and resistors R-763 and R-764 are applied directly to the differential amplifier Q-760C and Q-760D. The single ended output from Q-760D is applied directly to the Cascode through R-775. Resistor R-767 allows compensation for the voltage offset in the differential amplifier Q-760.

The attenuator is a series of T pad attenuators that can be either switched in or out by the manual pushbuttons in the front panel of the instrument. These T pad attenuators are arranged such that the 50 ohm transmission line impedance is maintained regardless of which or how many of the attenuators is activated.

3.2.6.1 AM CIRCUITRY (Figure 6.5.3)

The amplitude modulation circuitry is a form of XY Multiplier utilizing the variable transconductance method. The realization of this method requires level shifting elements for both the controlling input as well as the signal inputs. It also requires a signal boosting which appears here in the form of a closed loop operational amplifier. Integrated circuit Q-1600 is also operated as a closed loop operational amplifier. This amplifier can accept inputs from the front panel external modulation input or from the internal carrier level control. The output of this operational amplifier is also level shifted in a negative direction by a fixed input reference. The output of this input conditioning amplifier is applied directly to the input level shifting network. This network is connected as a differential amplifier with a constant current source and non-linear load resistances comprised of the base emitter junction of two transistors. These non-linear load resistances operate as linearizing networks for the signals that are applied to the variable transconductance element. Integrated circuit Q-1615 consists of a series of matched transistors from which the differential pair and the non-linear load resistances are connected. Q-1620 is a discreet constant current source whose reference is supplied from the constant power supply potentials. The linearity adjustment R-1615 compensates for minute differences in the base emitter potentials of the transistors Q-1615B and C as well as the offsets inherent in the variable transconductance element. The carrier input to the variable transconductance element is also level shifted through the use of matched pair Q-1630A and B. These transistors are operated as a differential pair with a constant current source Q-1625 and again non-linear load resistors matched diodes D-1632A and B. Transistor Q-1625 is operated as a constant current source with a reference supplied by the instrument power supplies. The differential output available at the collectors of transistors Q-1630A and B along with its linearizing diodes is applied directly to the variable transconductance element again in differential form. Resistive network R-1641 and its adjustment R-1640 provide the necessary operating bias for the variable transconductance element and its load resistor R-1643. The output of the variable transconductance element at pin 6

3.2.6.1 AM CIRCUITRY (Figure 6.5.3) Cont'd

is applied directly to the summing node of the closed loop operational booster amplifier. Resistor R-1644 (a very low value) provides some high frequency isolation in this signal path. The booster amplifier as shown is very similar in circuitry to the preamplifier as used in the main generator conditioning circuitry. This amplifier is a closed loop amplifier whose gain setting resistor then is R-1700 and its adjustment R-1701. This amplifier is a high performance amplifier with two signal paths, one containing the path for lower frequencies from DC to approximately 100KHz and the other path for high frequencies above 100KHz. The high frequency portion of the amplifier is comprised of two sets of Cascode amplifiers, that is one set Q-1660 and Q-1670 reference to the plus 15 volt supply and the other being Q-1665 and Q-1675 referenced to the minus 15 volt supply. The outputs of these two Cascode amplifiers are connected together through biased diodes D-1670 through D1676. The biased diodes provide the necessary quiescent operating bias for the input emitter followers Q-1680 and Q-1685. These first emitter followers drive a second pair (transistors Q-1690 and Q-1695). Also loading the first emitter followers is a bias diode network D-1680 and D-1685. The input connection to this high frequency path is at the junction of the two coupling capacitors C-1662 and C-1667. The Cascode amplifier Q-1660 and Q-1670 is operated at a slightly higher current level than its counterpart Q-1665 and Q-1675. This slightly higher current then allows a balancing current to be drawn through R-1657 to the double differential amplifier consisting of integrated circuit Q-1650. This connection allows amplification of the lowest frequency signals and injection of same at a convenient point in the amplifier. Input signals for the low frequency differential pair flow through resistor R-1650 to the base of the differential pair Q-1650A and B. The differential output available from these transistors is then applied to another differential pair Q-1650C and D. A single ended output then from this pair is applied directly through the isolating resistor R-1657 to the the Cascode transistors. The output of the buffer amplifier is then processed through isolating resistor R-1696 to the front panel switch that allows selection of the AM or normal modes of operation.

3.2.7 FUNCTION SWITCHING (Figure 6.5.2)

The triangular waveform generated in the main generator loop is applied to switch deck S-700A which for either a sine or triangular waveform connection applies it directly to switch deck S-700B. This waveform then is applied to switch S-700B which applies it directly to the pre-amplifier. S-700B also applies the triangular waveform from S-700A and the sine waveform from the sine amplifier directly to the pre-amplifier. Switch deck S-700K is utilized to either activate or deactivate the square amplifier for the square waveform.

3.2.8 LOCKOUT LOGIC (Figure 6.6.1)

Integrated circuit Q-500 is a high speed differential amplifier. Q-500D section of the same is operated as a level boosting amplifier for the trigger input circuitry. The input signals for the trigger modes are from schematic 5A and processed through summing resistor R-504. The gate trigger potentiometer R-503 and the summing resistor R-502 provides a means of offsetting the current supplied through the external trigger voltages such that the trip point level can be varied over a very wide dynamic range. The resultant signal is applied to pin 6 positive input of the integrated circuit amplifier. The inverting input is terminated in a resistor R-509 and also at this point a signal from the manual pushbutton is injected through the use of R-505 and R-506. Capacitor C-500 prevents multiple triggering from contact bounce. The output of the integrated circuit amplifier Q-500D is fed directly into the positive input of Q-500A. Q-500A is wired such that it operates as a Schmitt trigger whose reference is the internal reference built into the differential amplifier package. The positive feedback necessary for Schmitt trigger action is through resistor R-500 and R-501. The output of the integrated circuit comparator is fed through relay K-510 to the lockout flip-flop. Relay K-510 is controlled by the mode switching connections on schematic 5A. The lockout flip-flop is a set/re-set flip-flop with the capability of accepting an input on pin 12 for a continuous Run command as shown on schematic 5A. Any Run command applied to the inputs of Q-510A will override the re-set from Q-510B. As any Run command is removed from 510A then a re-set signal at the inputs of Q-510B will re-set the flip-flop causing the generator to lockout. The resistive dividers R-511 and R-510 and another divider R-514 and R-515 allow selection of the polarity of the lockout re-set signal. Voltages selected by the switching in Schematic 5A are applied to these dividers activating only one divider at a time placing the switch point of the re-set inputs near its trip point potential. The opposite one then will be biased to a point out of the range of tripping Q-510B. The differential signal output available at Q-510A is applied directly to the differential pair Q-520 and Q-525. This transistor pair provides signals suitable for application to the main generator lockout current sources. The diode clamping networks D-516 through D-531 prevent saturation in the driver transistors. Tp518 and resistive divider R-516 through R-518 is capable of accepting a ground signal to place the generator in the free run mode.

3.2.9 PHASE LOCK AND MODE SWITCHING (Figure 6.6.2)

The phase lock circuitry consists of the switching bridge diodes D-1400 through D-1403 (which generates a constant amplitude for the variable pulse width information) a phase lock amplifier and a phase lock lamp driver all coupled together with the phase lock switching logic. The variable pulse width information received from the main generator loop trigger

3.2.9 PHASE LOCK AND MODE SWITCHING (Figure 6.6.2) Cont'd

circuitry is processed through the diode switching bridge which maintains a constant amplitude and is then summed together with the variable phase information from the front panel phase control. The summation of these two quantities is realized through the use of the phase lock amplifier which is a closed loop operational type amplifier. The feedback components for this operational amplifier consists of resistor R-1501 which sets the DC gain and the capacitor C-1500 which selects the proper operating bandwidth of this amplifier for each different frequency range. The operational amplifier itself consists of two signal paths. One path for frequencies from DC to approximately 100KHz and the other path for frequencies of 100KHz and above. These two signals then are mixed in the differential mixer Q-1440 and Q-1445 and the differential output available from this mixer is then applied directly from one output and inverted through the use of Q-1450 and applied again in the same polarity to the main output buffer amplifiers Q-1455 and Q-1460. Diodes D-1450 and D-1445 generate a quiescent operating bias for the output emitter followers. The input amplifier for the high frequency channel is Q-1425 which is an AC coupled high frequency field effect transistor. The low frequency input channel is a differential field effect transistor amplifier whose differential output is then applied to another differential amplifier Q-1430 and Q1435. The single ended output then of this second amplifier is then taken from Q-1435 and applied to the input of the differential mixer at the base of Q-1440. The output of this phase lock amplifier is applied to the phase lock lamp driver which in effect is a voltage level discriminator. This circuitry determines when the output of the phase lock amplifier is within a specified operating range and as the voltage goes out of this range a voltage either positive or negative is developed at the bases of the two transistors Q-1470 and Q-1475 which, depending on direction, will activate either transistor placing it in collector saturation. Saturation of Q-1470 in the event of a positive going output from the phase lock amplifier will directly shunt any base current that may be applied to the output transistor Q-1485. Saturation of transistor Q-1475 which occurs in the event of any excursion in the negative direction greater than a normal operating range will saturate transistor Q-1480 which also shunts any available base current drive for the transistor Q-1485. Lack of any base drive, of course, will deactivate the transistor switch Q-1485 which causes the lamp to extinguish. The output of the phase lock amplifier is applied to the Phase lock On switch through compensated voltage divider R-1502 and R1503 and applied directly to the VCF amplifier through R-241. S-1500A is used to apply 3.2V to the reed relay which removes the offset voltage from the trigger input comparator giving it maximum sensitivity. It is also used to activate the the phase lock lamp driver and defeat the lock out current sources through the switching diodes at tp359 on schematic 6. Sections C and D of S-1500 are used in conjunction with S-1501 to provide the normal and the -180° polarity selection through the use of application of the power supply potentials to the lockout flip-flop connections. Switch S-510 the Gate/Trigger selector can apply the 3.2 volts available through the phase lock switch to the reed relay on schematic 5. This, then can provide gated or triggered mode of operation. The 3.2 volts available from the phase lock switch can also be applied through the Run switch to pin 12 of Q-510 activating the lockout flip-flop and causing the generator to run continuously.

3.2.10 LOCKOUT AMPLIFIER (Figure 6.7.1)

The lockout amplifier circuitry consists of a phase supply (to which the main generator timing capacitor voltage is clamped for lockout) a negative lockout current source which balances out the timing current at lockout and a lockout level shifting amplifier which supplies frequency tracking voltage for the lockout current source. This lockout level shifter is a closed loop operational current source whose input is derived from the level shifting amplifiers in the main generator loop at Q-270. This input is applied directly to the positive input of the integrated circuit amplifier Q-345. The amplifier is wired for a unity gain with an input resistor of R-345. As the voltage at tp350 tracks the timing voltage available at the input the current developed at R-345 becomes equal to the current available at the collector of transistor Q-350. This current is applied to R-360. This load resistor then provides a signal opposite in polarity to the voltage available from schematic 2 at Q-270. This voltage then is applied to the operational negative lockout current source. The input connections to this current source are buffered through the use of dual field effect transistor Q-355 for operation at the low values of current required by range switching. The output of the buffer transistors are applied differentially to the input of integrated circuit Q-360. Buffer transistor Q-365 then closes the loop by an emitter connection back to the gate of transistor Q-355. The effective range of input currents then are selected by the main range switch S-400E and the range setting resistors R-360 through R-364. The output current available through R-365 is then applied to the lockout diodes D-355 through D-360. Lockout is accomplished when diodes D-359, D-360, D-358 and D-357 are reversed biased and not conducting. Diodes D-355, D-356, D361 and D-362 then share equal current flow causing the voltage from tp422 in the buffer amplifier in the main generator to be clamped to the voltage available at the output of the phase supply at the junction of R-385 and R-393. Diodes D-359 and D-360 provide a means of interrupting the lockout source through the use of a positive potential at tp359 creating a free running generator for use during phase lock operations. Diodes D-358 and D-357 receive the signals from the lockout drivers which select when the lockout is to occur. The phase supply is a closed loop buffered operational amplifier whose input is derived from the rotation of the phase potentiometer connected to the positive and negative 15 volt supplies. Resistor R-371 is the input resistor for this closed loop operation and R-373 the feedback resistor. The output of the integrated circuit amplifier is applied to both bases of transistors Q-375 and 380. Outputs then are taken at the emitters creating a voltage differential equal to the proper polarity for quiescently biasing the output emitter followers Q-385 and Q-390. The output voltage from this phase supply is also applied at tp374 to the phase lock amplifier for creating a variable phase reference in relation to the phase information from the lockout circuitry.

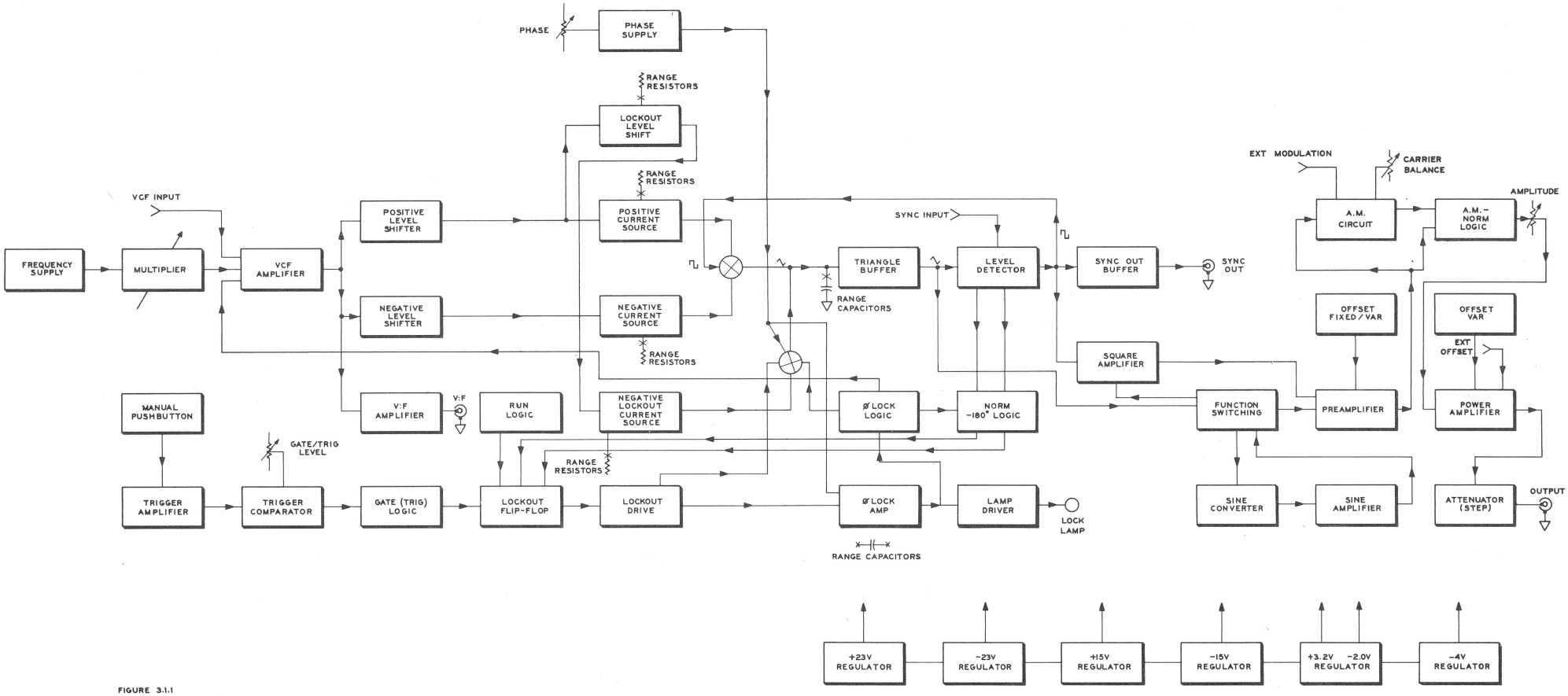
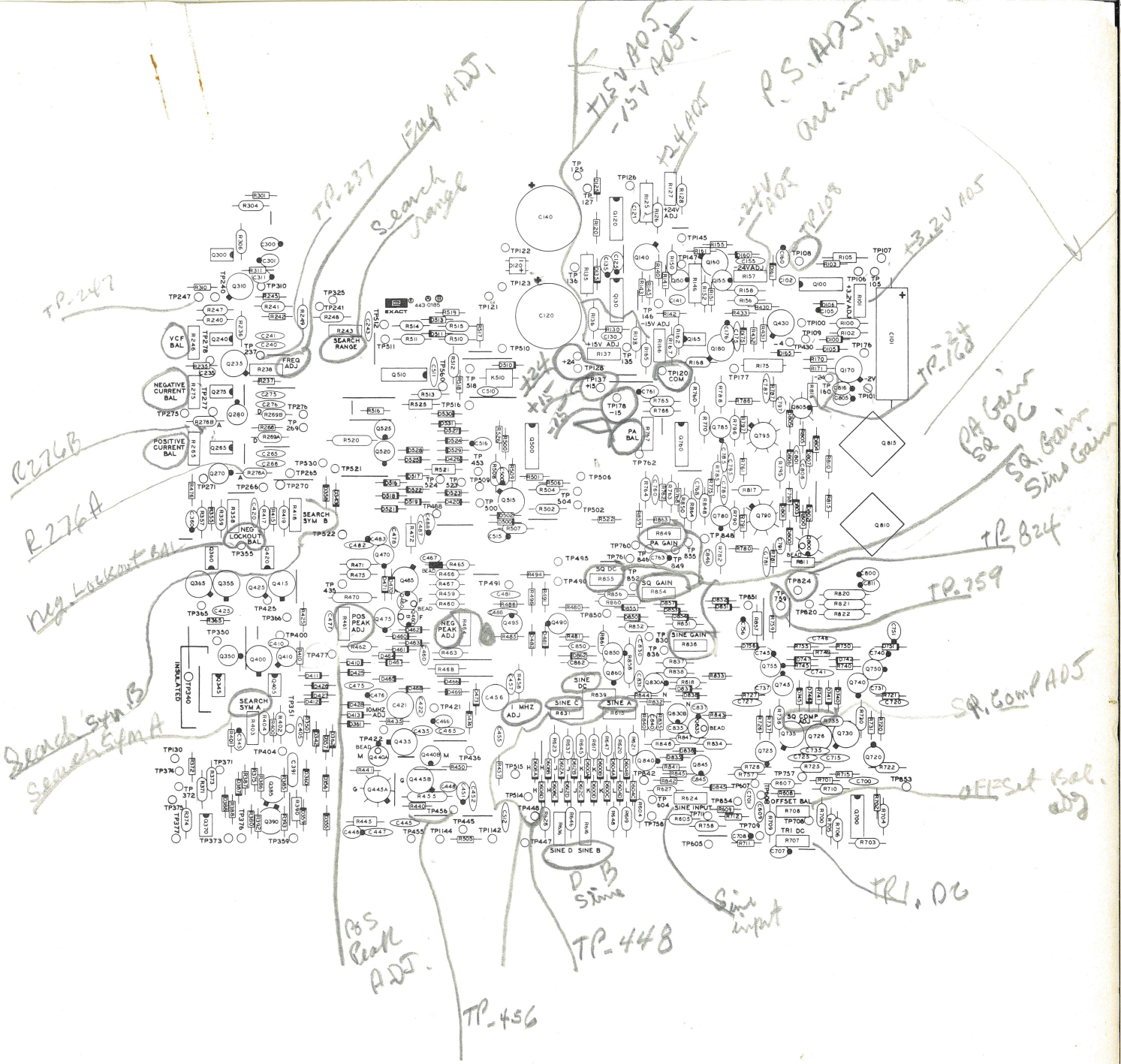


FIGURE 3.1.1
BLOCK DIAGRAM (F)


TP-237
Search range
+24 ADJ.
+15V ADJ.
-15V ADJ.
P.S. ADJ. one in this area
+24V ADJ
+3.2V ADJ
TP-247
TP-168
PA Gain SQ DC
SQ. Gain Sine Gain
R276B
R276A
Neg. Lockout BAL
TP-824
TP-759
Search Sym B
Search Sym A
SQ. COMP ADJ
OFFset Bal. adj
TRI. DC
Sine input
D B Sine
TP-448
QS Peak ADJ.
TP-456
EXACT
443-0165
SEARCH RANGE
FREQ ADJ
YCF BAL
NEGATIVE CURRENT BAL
POSITIVE CURRENT BAL
NEG LOCKOUT BAL
SEARCH SYM B
SEARCH SYM A
INSULATED
POS PEAK ADJ
NEG PEAK ADJ
1 MHZ ADJ
SINE DC
SINE C
SINE A
SINE D
SINE B
SQ DC
SQ GAIN
SINE GAIN
PA GAIN
PA BAL
SQ COMP ADJ
OFFSET BAL
TRI DC
SINE INPUT
+15V ADJ
-24VADJ
+24VADJ
+3.2V ADJ
TP825
TP823
TP831
R823
R825
R824
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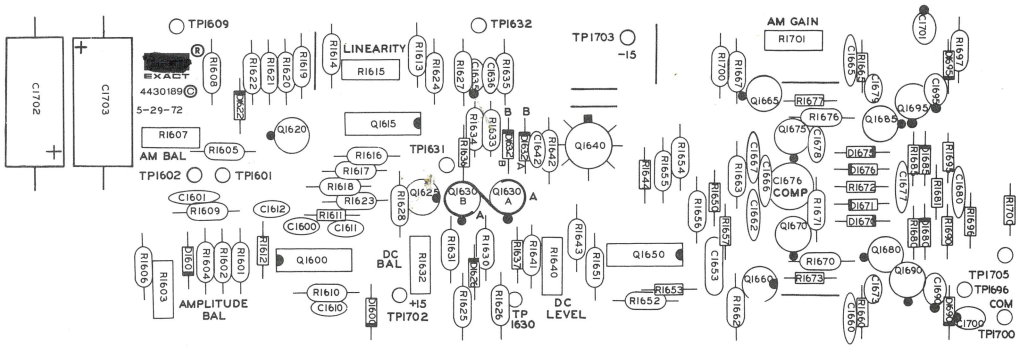
R828
R827
R829
R831
R830
12-3-71


TP1609
EXACT
4430189
5-29-72
C1702
C1703
R1608
R1622
R1621
R1620
R1619
R1614
LINEARITY
R1615
R1613
R1624
TP1632
TP1703
-15
AM GAIN
R1701
C1701
R1697
R1700
R1667
Q1665
R1677
R1676
Q1695
Q1684
Q1675
Q1678
D1674
D1676
D1672
D1671
D1679
C1676
COMP
R1671
Q1670
R1670
Q1680
Q1690
R1673
TP1705
TP1696
COM
TP1700
R1607
AM BAL
R1605
Q1620
Q1615
TP1602
TP1601
TP1631
R1616
R1617
R1618
R1623
C1601
R1609
C1612
R1611
C1600
C1611
R1612
Q1600
R1606
D1603
R1604
R1602
R1601
R1603
AMPLITUDE
BAL
R1610
C1610
D1607
DC
BAL
R1628
Q1629
Q1630
R1632
+15
TP1702
R1631
R1630
R1625
R1626
TP
1630
R1637
R1641
R1640
DC
LEVEL
R1643
R1651
Q1650
R1653
R1652
R1644
R1654
R1655
R1656
R1657
C1653
R1662
R1663
C1667
C1666
C1662
R1664
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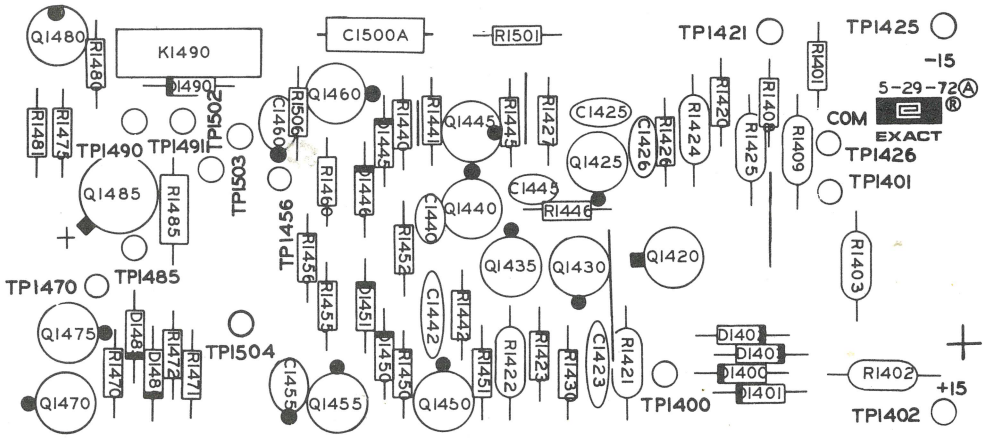
C1664
C1663
R1660
C1660
C1700
R1703


Q1480
R1480
K1490
D1490
C1500A
R1501
TP1421
TP1425
-15
5-29-72
EXACT
COM
TP1426
TP1401
R1401
R1420
R1424
R1408
R1425
R1409
R1481
R1473
TP1490
TP1491
TP1503
TP1502
C1460
R1506
Q1460
R1440
R1441
Q1445
R1443
R1427
C1425
Q1425
C1426
R1426
C1445
R1446
Q1485
R1485
R1460
D1448
C1440
Q1440
R1452
Q1435
Q1430
Q1420
R1403
TP1485
TP1470
TP1459
R1456
R1453
D1451
C1442
R1442
R1422
R1423
R1430
C1423
R1421
TP1400
D1402
D1403
D1400
D1401
R1402
+15
TP1402
Q1475
D1481
R1472
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TP1504
Q1470
C1455
Q1455
Q1450
R1450
R1451

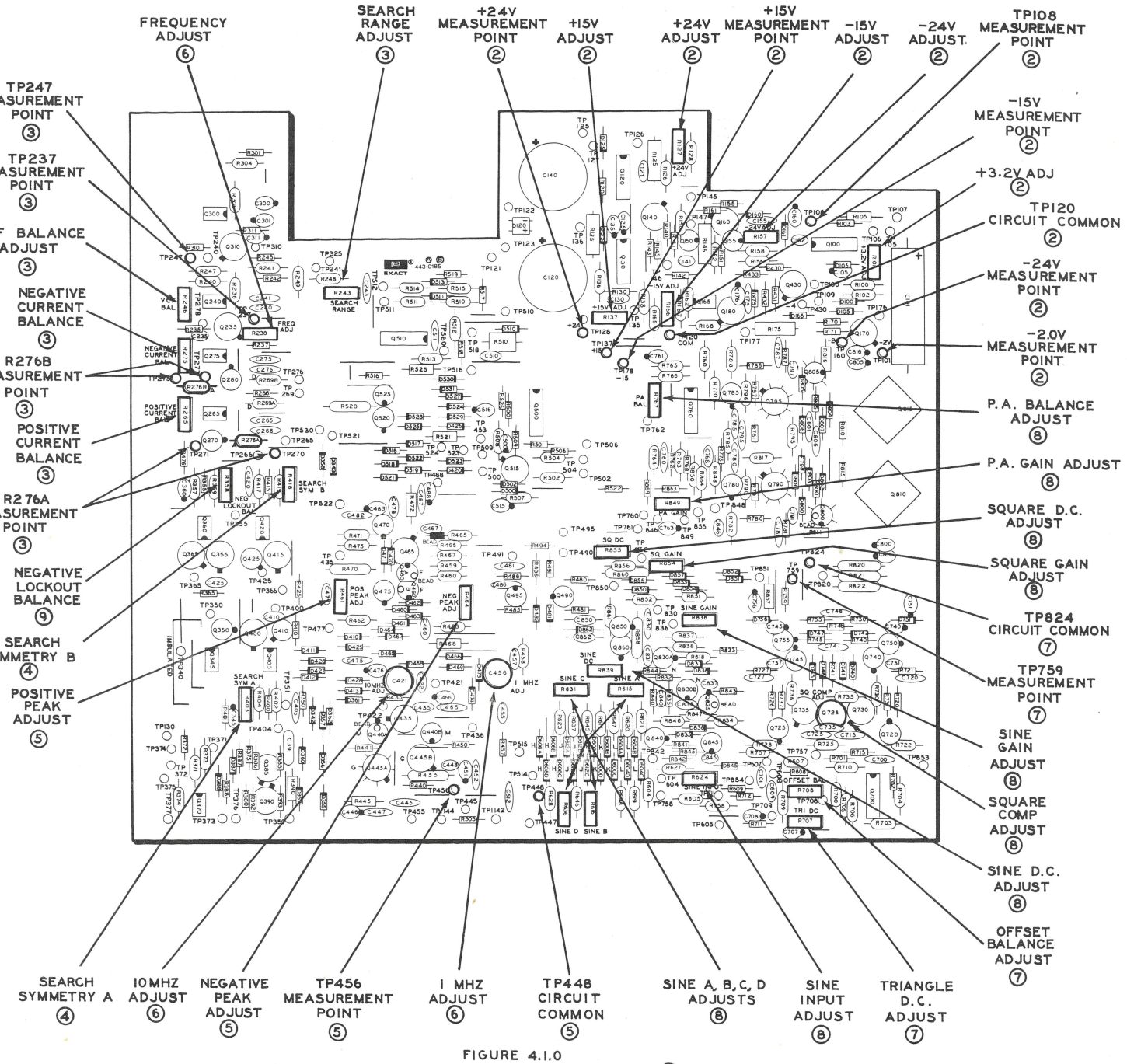
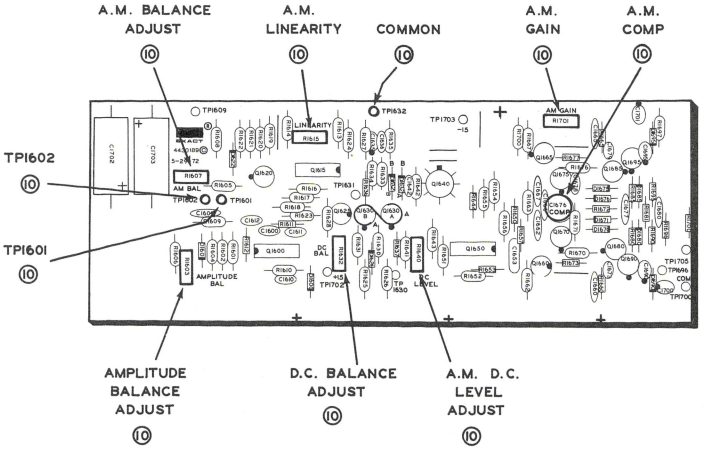


FIGURE 4.1.0
ADJUSTMENT LOCATION DETAIL (F)

NOTES:

1. ◯ INDICATES CALIBRATION SEQUENCE

REV B



NOTE:
1. ◯ INDICATES CALIBRATION SEQUENCE

FIGURE 4.1.1
ADJUSTMENT LOCATION DETAIL (F)

SECTION 4

CALIBRATION PROCEDURE

4.1.0 EQUIPMENT REQUIRED

This unit must be on for one hour with the covers in place and the output terminated into 50Ω before calibration.

The following equipment or suitable equivalents of known accuracy are required for complete calibration of the Model 7056.

Oscilloscope D.C. to 90MHz Differential input with 5mv/cm sensitivity.
Tektronix 7704 with 7A13 plug-in.

Counter-Timer 11MHz to 10,000 seconds.
DANA 8010B or equivalent.

Digital Voltmeter .01% accuracy with 1000 megohm input impedance floating inputs.
DANA 4300

Harmonic Distortion Analyzer <.1% Residual Distortion
Hewlett Packard 333.

Function Generator - linear 1ms ramp of ± 5V peak
Exact Model 7030 or equivalent.

1. INITIAL CONTROL SETTINGS

POWER SWITCH	On
MULTIPLIER	1.0
RANGE	1K
FUNCTION	Triangle
AMPLITUDE	Full clockwise
ATTENUATOR	Not Activated (0db)
OFFSET	Not Activated (Off)
RUN	Activated
GATE/TRIGGER LEVEL	Mid range
AM	Not Activated
PHASE	Mid range
PHASE LOCK ON	Not Activated
PHASE LOCK -180°	Not Activated
VARIABLE SYMMETRY	Not Activated

2. Using DVM: (With tp120 as common) (Fig. 4.1.0)

A. Probe +24V measurement point (tp128) and adjust the +24V Adjust for +24.00V ± .01V.
B. Probe -24V measurement point (tp160) and adjust the -24V Adjust for -24.00V ± .01V.
C. Probe +15V measurement point (tp137) and adjust the +15V Adjust for +15.00V ± .01V.
D. Probe -15V measurement point (tp178) and adjust the -15V Adjust for -15.00V ± .01V.
E. Probe +3.2V measurement point (tp108) and adjust the +3.2V Adjust for 3.20V ± .01V.
F. Probe -2.0V measurement point (tp210) and check for -2.0V ± .20V.

3. Using DVM (with tp325 as Common)

   A. Probe tp247 and adjust VCF Bal Adjust for 0.000V ± .1mV.
   B. Set Multiplier Dials to .10 and measure the voltage at tp237. -470
   C. Connect DVM across R276B (refer to Adjustment Loc. Detail Figure 4.1.0) and adjust Negative Current Bal Adjustment for a reading of the same absolute value of the same reading obtained in "B" above ± .5mV.
   D. Connect DVM across R276A (refer to Adjustment Loc Detail Figure 4.1.0) and adjust the "Positive Current Bal" Adjust for an absolute value of the same reading obtained in "B" above .5mV.
   E. Set Multiplier to S-0 and probe tp237. Adjust the Search Range Adjust for a voltage between -4 and -5 millivolts.

4. Set Function to Square Range to 1M, Multiplier to S-X. Monitor the output with the Oscilloscope.

   A. Using oscilloscope set to .1μ per Cm, check for approximately 1 cycle of square wave on screen.
   B. Set Multiplier to S-0 (against the stop) and set the oscilloscope Horizontal Sweep Speed for .1ms per Cm. Adjust Search Sym A and Search Sym B for a time Symmetrical square wave that is slightly greater (approximately 2 millimeters) than 10 Cm. at .1ms per Cm.

5. Set Function to Triangle, set Range to 1K, set Multiplier to 1.0.

   A. Monitor 456 using tp448 as a ground with the comparator oscilloscope. Adjust the Positive Peak Adjust for a positive triangle peak voltage of +1.000V ± 1mV. Adjust the Negative Peak Adjust for a negative triangle peak voltage of -1.000V ± 1mV.

6. Set Function to Square and monitor the main output of the generator with the Frequency Counter.

   A. Adjust the Frequency Adjust for a generator frequency of 1.000KHz. Check each range for timing accuracy for the .01Hz range to the 1MHz range. (It may be necessary to re-adjust the Frequency Adjustment so that all ranges fall within specifications.)
   B. Set Multiplier to 1.0 and range to 1M. Adjust the 1MHz adjust for a frequency of 1MHz ± 1%.
   C. Set range to 10M. Adjust the 10MHz adjust for a frequency of 10MHz ± 1%.
   D. Repeat steps B and C due to interaction.

7. Reset Function to Triangle and reset Range to 1K, Multiplier to 1.0.

   A. Connect oscilloscope to tp759 using tp824 as a ground. Adjust the Triangle D.C. Adjust for equal ± peaks ± 5mv.
   B. Depress Fixed Offset and adjust the Offset Bal Adjust for a triangle starting at 0 volts ± 5mv.

8. Deactivate Offset and Neg. Connect oscilloscope to terminated main output.

   A. Adjust PA Bal Adjust (D.C.) and the PA Gain Adjust for a triangle of 15.00V +20/-0mv peak to peak.
   B. Switch Function to Square and adjust the Square Gain Adjust and the Square D.C. Adjust for a square wave of 15.00V +20/-0mv.
   C. Switch Function to Sine and connect the harmonic distortion analyzer to the main output (terminated). Adjust the Sine Input Adjust and SineA, Sine B, Sine C, and Sine D Adjusts for minimum Sine distortion.
   D. Connect oscilloscope to main output (terminated) and Adjust the Sine Gain Adjust and Sine D.C. Adjust for an output of 15.00V +20/-0mv peak to peak.
   E. Set Function to Square and Range to 10M. Adjust the Square Comp. Adjust for proper rise time, overshoot and sine rolloff.

9. Negative Lockout Bal. Set Function to Triangle, Range to 1 meg, Multiplier to S-X, Run Pushbutton out (triggered), Gate/Trigger pushbutton out (triggered). Monitor main output with oscilloscope.

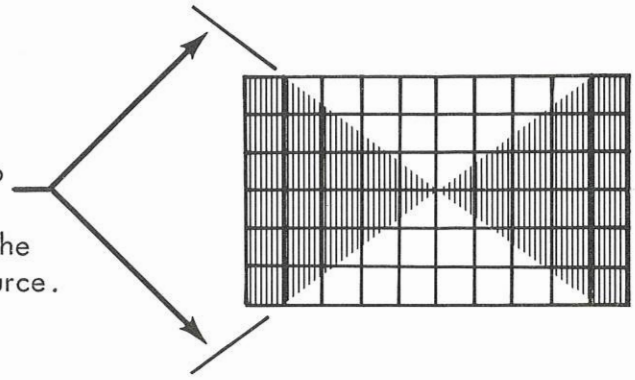
   A. With oscilloscope set at 5ms/cm, set Phase control for approximately 0V D.C. level at output. Rotate vernier from S-X toward S-0 and adjust Negative Lockout Balance to obtain 0V D.C. level shift from S-X to S-0 on vernier dial.

10. Set Range to 100K, Multiplier to 1.0, Function to Sine, Amplitude to maximum or full clockwise, depress the AM button, and depress the Run button (Figure 4.1.1)

    A. Connect the DVM to tp1602 using tp1632 as common and adjust the AM Balance Adjustment for 0V ± 1mv.
    B. Connect the DVM to tp1601 using tp1732 as common and preset the Carrier Level potentiometer on the front panel for a reading of 0V ± 50mv.

10. Continued

C. Connect a 1ms ramp of 10V peak to peak to the External modulation input. Monitor the main output with the oscilloscope and adjust its controls so that a bow tie waveform is presented. Synchronizing the oscilloscope with the Ramp Generator will present the most stable display. It may be necessary to reduce the level of the ramp waveform to prevent overdrive at the output connector (15V peak to peak maximum into 50Ω).
Adjust the AM Linearity control and the Amplitude Balance Adjust alternately so that the most linear display is obtained as shown in the figure below.
(It may be necessary to pre-adjust the D.C. Balance Adj. so that the bow tie as shown is not tilted).



The amplitude balance control will return amplitude null in the display to the center of the CRT after any change has been made via the linearity control.

D. Connect the harmonic distortion analyzer to the main output connector and remove the Ramp generator connection. Readjust the Amplitude Balance potentiometer so that as the front panel Carrier Level control is rotated to either extreme an equal voltage is available for each polarity. An AC reading DVM could also be used for this measurement.
E. Monitoring the main output again with the oscilloscope, adjust the D.C. Balance Adjust so that whatever DC offset is present at the main output connector is equal for each polarity as the Carrier Level control is rotated to each extreme.
F. Adjust the AM D.C. Level Adjust and the AM Gain Adjust so that at the main output connector 15.00V +20/-0mv is obtained without D.C. offset at maximum Carrier Level (either polarity).
G. Switch Range to 1M and Function to Square and Sine alternately to adjust the AM Comp for best rise time, overshoot and sine rolloff.

SECTION 5

PARTS LIST

CODE LIST OF MANUFACTURERS

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Sprgs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00334	Humidail Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Prod. Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Eng. Labs, Inc.	Burlington, Wis.
00853	Sangamo Electric Co. Ordill Div. (Caps)	Marion, Illinois
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc. Transistor Prod. Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassl-Trak Corp.	Indianapolis, Inc.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Illinois
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp/Amer.	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg El. Corp.	Chicago, Illinois
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vacaline Company of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine and Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Electric Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q, Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co. Electronics Div.	Burbank, Calif.
04354	Precision Paper Tube Co.	Chicago, Illinois
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prod., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola/Semicon. Prod.	Phoenix, Arizona
04732	Filtron Co/Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Illinois
04777	Automatic Elect. Sales Corp.	Northlake, Illinois
04796	Sequoia Wire/Cable Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Co.	Chicago, Illinois
05006	20th Century Plastics	Los Angeles, Calif.
05277	Westinghouse/Semicon. Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illuminatic Eng. Co.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Illinois
05728	Tiffen Optical Co.	Roslyn Heights, L.I., N.Y.
05729	Metropolitan Telecomm. Corp Metro Cap Div.	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	The Bassick Co.	Bridgeport, Conn.
06175	Bausch and Lomb Optical	Rochester, N.Y.
06402	E.T.A. Products/Amer.	Chicago, Illinois
06475	Western Devices, Inc.	Inglewood, Calif.
06540	Amatom Elect. Hardware Co.	New Rochelle, N.Y.
06555	Beede Electrical Inst.Co.	Penacook, N.H.
06751	U.S. Semcor Div. of Nuclear Corp/Amer.	Phoenix, Ariz.
06812	Torrington Mfg Co, West Div.	Van Nuys, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07115	Corning Glass Works Electronics Comp. Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	The Birtcher Corp.	Los Angeles, Calif.
07700	Technical Wire Products	Springfield, N.J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07966	Shockley Semi-Conductor Labs	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert, Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario
08717	Sloan Company	Burbank, Calif.
08718	Cannon Elect Co., Phoenix Div.	Phoenix, Ariz.
08792	CBS Elect. Semiconductor Oper., Div. C.B.S., Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Atohm Electronics	Sun Valley, Calif.
09250	Electro Assemblies, Inc.	Chicago, Illinois
09569	Mallory Battery Ca/Canada Ltd.	Toronto, Ontario, Canada
09664	The Bristol Company	Waterbury, Conn.
10214	Gen. Trans. Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10597	Exact Electronics, Inc.	Hillsboro, Oreg.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Tel. of Calif., Inc.	S. Pasadena, Calif.
11312	Microwave Elect. Corp.	Palo Alto, Calif.
11534	Duncan Electronic, Inc.	Santa Ana, Calif.
11711	Gen'l Inst/Semiconductor Div	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12136	Philadelphia Handle Co.	Camden, N.J.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Elect. Co., Ltd.	Tokyo, Japan
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
13103	Thermalloy	Dallas, Texas
13396	Telefunken (G.M.B.H.)	Hannover, Germany
13835	Midland Mfg. Co.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components Inc.	Conshohocken, Pa.
14655	Cornell Dubilier El. Corp.	So. Plainfield, N.J.
14936	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Elect., Co., Inc.	Brooklyn, N.Y.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15909	The Daven Co.	Livingston, N.J.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16352	Computer Diode Corp.	Lodi, N.J.
16688	De Jur-Amsco Corp.	Long Island City, N.Y.
16758	Delco Radio, Division of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics, Inc.	Canoga Park, Calif.
17474	Transe Company	Mountain View, Calif.
18486	Radio Industries	Des Plaines, Illinois
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18873	E.I. Dupont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries Div. McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21226	Executive, Inc.	New York, N.Y.
21520	Fansteel Metallurgical Corp.	No. Chicago, Illinois
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E. Lamp Div.	Nela Park, Cleveland, Ohio
24655	General Radio Co.	W. Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co/America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	GE Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm, Inc.	Chicago, Ill.
36196	Stanwyck Corp.	Hawkesburn, Ontario, Cd.
37942	P.R. Mallory and Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod.	Akron, Ohio
40920	Miniature Precision Bearings	Keene, N.H.
42190	Muter Co.	Chicago, Illinois
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Illinois
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer/Inst.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
52090	Rowan Controller Co.	Baltimore, Md.
63743	Ward Leonard Electric	Mt. Vernon, N.Y.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Illinois
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Sorenson and Co., Inc.	S. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	N. Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
59730	Thomas and Betts Co.	Elizabeth, N.J.
60741	Tripplett Electrical Inc.	Bluffton, Ohio
61775	Union Switch and Signal, Div. Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Ososso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	West Inst./Div. Daystrom	Newark, N.J.
66295	Wittek Manufacturing Co.	Chicago, Illinois
66346	Wollensak Optical Co.	Rochester, N.Y.
70276	Allen Manufacturing Co.	Hartford, Conn.
70309	Allied Control Co., Inc.	New York, N.Y.
70319	Allmetal Screw Prod. Co, Inc.	Garden City, N.Y.
70485	Atlantic India Rubber Works	Chicago, Illinois
70563	Amperite Co., Inc.	New York, N.Y.
70903	Belden Manufacturing Co.	Chicago, Illinois
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Allen D. Cardwell Elect. Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Illinois
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C.P. Clare and Co.	Chicago, Illinois
71590	Centralab, Div. Globe Union, Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Illinois
71700	The Cornish Wire Co.	New York, N.Y.
71744	Chicago Miniature Lamp Wks	Chicago, Illinois
71753	A. O. Smith Corp. Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Corp.	Chicago, Illinois
71984	Dow Corning Corp.	Midland, Mich.
72092	Eitel-McCullough, Inc.	San Bruno, Calif.
72136	Electro Motive Mfg. Co, Inc.	Willimantic, Conn.
72707	Coto Coil, Co., Inc.	Providence, R.I.
72354	John E Fast and Company	Chicago, Illinois
72619	Dialight Corp.	Brooklyn, N.Y.
72656	General Ceramics Corp.	Keasbey, N.J.
72699	General Instrument Corp. Semiconductor Div.	Newark, N.J.
72758	Girard-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Illinois
72825	Hugh H. Eby, Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Illinois
72965	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H. M. Harper Co.	Chicago, Illinois
73138	Helipot, Div. Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Div. of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. No. American Phillips Co., Inc.	Hicksville, N.Y.
73490	Beckman Helipot Corp.	S. Pasadena, Calif.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
73734	Federal Screw Prod. Co.	Chicago, Illinois
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73846	Goshen Stamping and Tool	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74276	Signalite, Inc.	Neptune, N.J.
74455	J. H. Winns and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Illinois
74868	R.F. Prod. Div. of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Div. of Cinch Mfg. Corp.	Chicago, Illinois
75378	James Knights Co.	Sandwich, Illinois
75382	Kulka Electric Corp.	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Illinois
75915	Littlefuse, Inc.	Des Plaines, Illinois
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76854	Oak Manufacturing Co.	Crystal Lake, Illinois
77068	Bendix Pacific Div. of Bendix Corp.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostran Instrument and Electronic Co.	S. Pasadena, Calif.
77250	Phoell Manufacturing Co.	Chicago, Illinois
77252	Philadelphia Steel and Wire Corporation	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine/Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof, Div. of Illinois Tool Works	Elgin, Illinois
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn, Inc.	Pitman, N.J.
78452	Thompson-Bremer and Co.	Chicago, Illinois
78471	Tilley Manufacturing Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Illinois
79727	Continental-Wirt Elect. Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco, Div. of Sessions Clock Company	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Assoc. Any brand tube meeting EIA standards.	Washington D.C.
80207	Unimax Switch, Div. of W L Maxson Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Illinois
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro, Div. Robershaw Fulton Controls Co.	Columbus, Ohio
80486	All Star Products, Inc.	Defiance, Ohio
80509	Avery Adhesive Label Corp.	Monrovia, Calif.
80583	Hammerlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81073	Graychil Co.	LaGrange, Illinois
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Electronics Co,	Norwalk, Conn.
81349	Military Specifications	.....
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div, Industrial Tube Oper.	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81541	The Airpax Products Co.	Cambridge, Mass.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Illinois
82142	Jeffers Electronics, Div. of Speer Carbon Co.	DuBois, Pa.
82170	Allen B. DuMont Labs, Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod., Electronic Tube Div.	Emporium, Pa.
82376	Astron Company	E. Newark, N.J.
82389	Switchcraft, Inc.	Orange, Illinois
82647	Metals and Controls, Inc., Div. Texas Instruments, Spencer Products	Attlebora, Mass.
82866	Research Products Corp.	Madison, Wisc.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, California
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing Pyramid Electric Co.	Peterborough, N.H.
83125	Electro Cords Co.	Darlington, S.C.
83148	Victory Engineering Corp.	Los Angeles, Calif.
83186	Bendix Corp/Red Bank Div.	Springfield, N.J.
83298	Hubbell Corp.	Red Bank, N.J.
83315	Smith, Herman H., Inc.	Mundelein, Illinois
83330	Central Screw Co.	Brooklyn, N.Y.
83385	Gavitt Wire and Cable Co., Div. Amerace Corp.	Chicago, Illinois
83501	Burroughs Corp., Electronic Tube Div.	Brookfield, Mass.
83594	Eveready Battery	Plainfield, N.J.
83740	Model Eng. and Mfg., Inc.	New York, N.Y.
83777	Loyd Scruggs Co.	Huntington, Ind.
83821	Arco Electronics, Inc.	Festus, Mo.
84171	A.J. Glessner Co., Inc.	New York, N.Y.
84396	Good All Electric Mfg. Co.	San Francisco, Calif.
84411	Sarkes Tarzian, Inc.	Ogallala, Neb.
84970	Boonton Molding Co.	Bloomington, Ind.
85454	R.M. Bracamonte and Co.	Boonton, N.J.
85474	Koiled Kords, Inc.	San Francisco, Calif.
85660	Seamless Rubber Co.	New Haven, Conn.
85911	Clifton Precision Products	Chicago, Illinois
86197	Precision Rubber Products Corp.	Clifton Heights, Pa.
86579	Radio Corp. of America, RCA Electron Tube Div.	Dayton, Ohio
86684	Philco Corp. (Lansing Div.)	Harrison, N.J.
87216	Western Fibrous Glass Products Co.	Lansing, Pa.
87474	Van Waters and Rogers, Inc.	San Francisco
87644	Tower Mfg. Co.	Seattle, Wash.
87930	Cutler-Hammer, Inc.	Providence, R.I.
88140	Gould-National Batteries, Inc.	Lincoln, Illinois
88220	General Mills, Inc.	St. Paul, Minn.
88698	Graybar Electric Co.	Buffalo, N.Y.
89231	Weldes Kohinoor, Inc.	Oakland, Calif.
89462	General Electric Distributing Corp.	Cambridge, Mass.
89473	Carter Parts Div. of Economy Baker Co.	Schenectady, N.Y.
89636	United Transformer Co.	Chicago, Illinois
89665	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
89679	Bearing Engineering Co.	San Francisco, Calif.
90970	Connor Spring Mfg. Co.	San Francisco, Calif.
91260	Miller Dial and Nameplate Co.	El Monte, Calif.
91345	Radio Materials Co.	Chicago, Illinois
91418	Augat Brothers', Inc.	Attleboro, Mass.
91506	Dale Electronics, Inc.	Columbus, Neb.
91637	Elco Corp.	Philadelphia
91662	Gremar Mfg Co., Inc.	Wakefield. Mass.
91737	Minneapolis-Honeywell Regulator Co., Microswitch Div.	Freeport, Illinois
91929	Nahm-Bros. Spring Co.	Oakland, Calif.
91961	Tru-Connector Corp.	Peabody, Mass.
92180	Universal Metal Prod., Inc.	Bassett Puente, Calif.
92196	Elgeet Optical Co., Inc.	Rochester, N.Y.
92367	Tinsolite Insulated Wire Co.	Tarrytown, N.Y.
92607	Sylvania Electric Prod, Inc. Semiconductor Div.	Woburn, Mass.
93332	Robbins and Myers, Inc.	New York, N.Y.
93369	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93410	Howard J. Smith, Inc.	Port Monmouth, N.J.
93788	G.V. Controls	Livingston, N.J.
93929	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.
93983	General Cable Corp.	Bayonne, N.J.
94137	Raytheon Mfg. Co., Industrial Comp. Div, Rec. Tube Div.	Quincy, Mass.
94144	Raytheon Mfg. Co., Semiconductor Div, Calif. St. Plt	Newton, Mass.
94145	Scientific Radio Products	Loveland, Colo.
94148	Tung-Sol Electric, Inc.	Newark, N.J.
94154	Curtiss-Wright Corp. Electronics Div.	E. Paterson, N.J.
94197	Southco, Div. S. Chester Corp.	Lester, Pa.
94222	Tru Ohm Prod., Div. Model Engineering and Mfg. Co.	Chicago, Illinois
94310	Wire Cloth Products, Inc.	Chicago, Illinois
94330	Worcester Pressed Alum. Corp.	Worcester, Mass.
94682	Philbrick Researchers, Inc.	Boston, Mass.
95023	Allies Products Corp.	Miami, Fla.
95236	Continental Connector Corp.	Woodside, N.Y.
95238	Leecraft Mfg. Co., Inc.	New York, N.Y.
95263	Lerco Electronics, Inc.	Burbank, Calif.
95264	National Coil Co.	Sheridan, Wyo.
95265	Vitramon, Inc.	Bridgeport, Conn.
95275	Gordas Corp.	Bloomfield, N.J.
95348	Methode Mfg. Co.	Chicago, Illinois
95354	Dage Electric Co., Inc.	Franklin, Ind.
95712	Weckesser Co.	Chicago, Illinois
95987	Huggins Laboratories	Sunnyvale, Calif.
96067	Hi-Q Div. of Aerovox	Olean, N.Y.
96095	Thordarson-Meissner, Div. Maguire Industries, Inc.	Mt. Carmel, Ill.
96256	Solar Manufacturing Co.	Los Angeles, Calif.
96296	Carlton Screw Co.	Chicago, Illinois
96330	Microwave Associates, Inc.	Burlington, Mass.
96341	Excel Transformer Co.	Oakland, Calif.
96501	Industrial Retaining Ring Co.	Irvington, N.J.
97464	Automatic and Precision Mfg.	Yonkers, N.Y.
97539	CBS Electronics Div. C.B.S., Inc.	Danvers, Mass.
97966	Reon Resistor Corp.	Yonkers, N.Y.
97979	Axel Brothers, Inc.	Jamaica, N.Y.
98141	Rubber Teck, Inc.	Gurdena, Calif.
98159	Francis L. Mosley	Pasadena, Calif.
98220	Microdot, Inc.	S. Pasadena, Calif.
98278	Sealectro Corp.	Mamaroneck, N.Y.
98291	Carad Corp.	Redwood City, Calif.
98405	General Mills	Minneapolis, Minn.
98731	North Hills Electric Co.	Mineola, N.Y.
98821	Clevite Transistor Prod. Div. Clevite Corp.	Waltham, Mass.
98925	International Electronic Research Corp.	Burbank, Calif.
98978	Columbia Technical Corp.	New York, N.Y.
99109	Varian Associates	Palo Alto, Calif.
99313	Marshall Industries, Electron Products Division	Pasadena, Calif.
99515	Control Switch Div, Controls Co. of America	El Segundo, Calif
99707	Delevan Electronics Corp.	E. Aurora, N.Y.
99800	Wilco Corporation	Indianapolis, Ind.
99848	Renbrandt, Inc.	Boston, Mass.
99934	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Illinois
99942	Technology Instrument Corp. of California	Newbury Park, Calif.
99957		

PART	DESCRIPTION	EXACT NO	MFG
C0101	CAPACITOR, 2000 MFD 15 VOLT	2900054	37942
C0102	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0105	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0120	CAPACITOR, 2500MFD 35V	2900034	853
C0121	CAPACITOR, 100PF MICA	2810537	853
C0125	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0130	CAPACITOR, 47PF MICA	2810532	853
C0135	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0140	CAPACITOR, 2500MFD 35V	2900034	853
C0141	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0155	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0160	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0175	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0176	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0235	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0240	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0241	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0243	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0265	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0266	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0275	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0276	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0300	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0301	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0311	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0345	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0360	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0391	CAPACITOR, 0,47MFD 75V	2900050	56289
C0405	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0410	CAPACITOR, SELECTED VALUE		
C0418	CAPACITOR, 39PF MICA	2810531	853
C0419	CAPACITOR, 10PF MICA	2810529	853
C0420	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0421	CAPACITOR, 5,5-18PF TRIM	2810011	72982
C0422	CAPACITOR, 7PF MICA	2810536	853
C0423	CAPACITOR, 39PF MICA	2810531	853
C0424	CAPACITOR, TIMING SET	2950004	10597
C0425	CAPACITOR, SELECTED VALUE		
C0435	CAPACITOR, 18PF MICA	2810552	14655
C0445	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0446	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0447	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0448	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0451	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0452	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0455	CAPACITOR, 180PF MICA	2810554	853
C0456	CAPACITOR, 5,5-18PF TRIM	2810011	72982
C0457	CAPACITOR, 47PF MICA	2810532	853
C0460	CAPACITOR, 7PF MICA	2810536	853
C0465	CAPACITOR, SELECTED VALUE		
C0475	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0476	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0477	CAPACITOR, 22PF MICA	2810530	853
C0478	CAPACITOR, 390PF MICA	2810556	853
C0481	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0482	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0483	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0486	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0487	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0488	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0500	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0510	CAPACITOR, 82PF MICA	2810533	853
C0511	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0512	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0515	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0516	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0609	CAPACITOR, 82PF MICA	2810533	853
C0700	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0707	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0708	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0715	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0720	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0725	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0726	CAPACITOR, 5,5-18PF TRIM	2810011	72982
C0727	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0731	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0735	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0737	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0740	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0741	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0745	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0746	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0751	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0756	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0760	CAPACITOR, 0,47MFD 75V	2900050	56289
C0761	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0763	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0768	CAPACITOR, 470PF MICA	2810539	853
C0780	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0781	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0785	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0787	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0791	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0795	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0797	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0800	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0801	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0805	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0806	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0811	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0816	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0817	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0818	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0830	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0831	CAPACITOR, 100PF MICA	2810537	853
C0835	CAPACITOR, 3PF MICA	2810500	853
C0837	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0840	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0845	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0846	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0850	CAPACITOR, 82PF MICA	2810533	853
C0862	CAPACITOR, 7PF MICA	2810536	853
C1408	CAPACITOR, 100PF MICA	2810537	853
C1423	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C1425	CAPACITOR, 5PF MICA	2810501	853
C1426	CAPACITOR, 120PF MICA	2810537	853
C1440	CAPACITOR, 1000 PF DISCAP	2830000	91418
C1442	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C1445	CAPACITOR, 5000 PF DISCAP	2830011	91418
C1455	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C1460	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C1500	CAPACITOR, TIMING SET	2950004	10597
C1502	CAPACITOR, 120PF MICA	2810537	853
C1601	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C1610	CAPACITOR, 22PF MICA	2810530	853
C1611	CAPACITOR, 22PF MICA	2810530	853
C1612	CAPACITOR, 22PF MICA	2810530	853
C1635	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C1636	CAPACITOR, 390PF MICA	2810556	853
C1642	CAPACITOR, 180PF MICA	2810554	853
C1653	CAPACITOR, 0,47MFD 75V	2900050	56289
C1660	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C1662	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C1665	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C1666	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C1667	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C1673	CAPACITOR, 1000 PF DISCAP	2830000	91418
C1676	CAPACITOR, 2-8PF TRIM	2810009	72982
C1677	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C1678	CAPACITOR, 3PF MICA	2810500	853
C1679	CAPACITOR, 1000 PF DISCAP	2830000	91418
C1690	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C1695	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C1701	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C1702	CAPACITOR, 100 MFD 35V	2900039	56289
C1703	CAPACITOR, 100 MFD 35V	2900039	56289
C1704	CAPACITOR, 1000 PF DISCAP	2830000	91418
D0100	DIODE, 1N4001	1524001	1295
D0105	DIODE, 1N4001	1524001	1295
D0126	DIODE, 1N4001	1524001	1295
D0120	RECTIFIER BRIDGE, MDA920A-3	1520920	4713
D0125	DIODE, 1N4001	1524001	1295
D0135	DIODE, 1N4001	1524001	1295
D0160	DIODE, 1N914	1520914	7910
D0161	DIODE, 1N4001	1524001	1295
D0165	DIODE, 1N757	1520757	1295
D0175	DIODE, 1N4001	1524001	1295
D0355	DIODE, CD1541	1521541	14655
D0356	DIODE, HOT CARRIER	1522835	10597
D0357	DIODE, HOT CARRIER	1522835	10597
D0358	DIODE, CD1541	1521541	14655
D0359	DIODE, CD1541	1521541	14655
D0360	DIODE, HOT CARRIER	1522835	10597
D0361	DIODE, HOT CARRIER	1522835	10597
D0362	DIODE, CD1541	1521541	14655
D0410	DIODE, HOT CARRIER	1522835	10597
D0411	DIODE, CD1541	1521541	14655
D0412	DIODE, CD1541	1521541	14655
D0413	DIODE, HOT CARRIER	1522835	10597
D0425	DIODE, HOT CARRIER	1522835	10597
D0426	DIODE, CD1541	1521541	14655
D0427	DIODE, CD1541	1521541	14655
D0428	DIODE, HOT CARRIER	1522835	10597
D0460	TO		
D0463	DIODE, HOT CARRIER	1522835	10597
D0464	DIODE, HOT CARRIER	1522835	10597
D0465	DIODE, 1N914	1520914	7910
D0466	DIODE, 1N914	1520914	7910
D0467	DIODE, HOT CARRIER	1522835	10597
D0468	DIODE, 1N914	1520914	7910
D0469	DIODE, 1N914	1520914	7910
D0470	DIODE, HOT CARRIER	1522835	10597
D0471	DIODE, HOT CARRIER	1522835	10597
D0473	DIODE, HOT CARRIER	1522835	10597
D0474	DIODE, HOT CARRIER	1522835	10597
D0481	DIODE, 1N914	1520914	7910
D0482	DIODE, 1N914	1520914	7910
D0500	TO		
D0503	DIODE, 1N914	1520914	7910
D0510	DIODE, 1N914	1520914	7910
D0511	DIODE, HOT CARRIER	1522835	10597
D0513	DIODE, HOT CARRIER	1522835	10597
D0516	DIODE, HOT CARRIER	1522835	10597
D0517	DIODE, HOT CARRIER	1522835	10597
D0518	DIODE, HOT CARRIER	1522835	10597
D0519	DIODE, 1N914	1520914	7910
D0520	DIODE, 1N914	1520914	7910
D0521	DIODE, HOT CARRIER	1522835	10597
D0522	DIODE, 1N914	1520914	7910
D0523	DIODE, 1N914	1520914	7910
D0524	DIODE, HOT CARRIER	1522835	10597
D0525	DIODE, 1N914	1520914	7910
D0526	DIODE, 1N914	1520914	7910
D0527	DIODE, 1N914	1520914	7910
D0528	DIODE, 1N914	1520914	7910
D0529	DIODE, 1N914	1520914	7910
D0530	DIODE, HOT CARRIER	1522835	10597
D0531	DIODE, HOT CARRIER	1522835	10597
D0600	DIODES, MATCHED 2835	1532835	10597
D0604	DIODES, MATCHED 2835	1532835	10597
D0608	DIODES, MATCHED 2835	1532835	10597
D0612	DIODES, MATCHED 2835	1532835	10597
D0682	DIODE, 1N749	1520749	1295
D0740	DIODE, 1N914	1520914	7910
D0741	DIODE, 1N914	1520914	7910
D0742	DIODE, 1N914	1520914	7910

PART	DESCRIPTION	EXACT NO	MFG
D0745	DIODE, 1N914	1520914	7910
D0746	DIODE, 1N914	1520914	7910
D0747	DIODE, 1N914	1520914	7910
D0751	DIODE, 1N753A	1520753	1295
D0756	DIODE, 1N753A	1520753	1295
D0800	DIODE, 1N914	1520914	7910
D0801	DIODE, 1N914	1520914	7910
D0802	DIODE, 1N914	1520914	7910
D0803	DIODE, 1N914	1520914	7910
D0804	DIODE, 1N914	1520914	7910
D0805	DIODE, 1N914	1520914	7910
D0806	DIODE, 1N914	1520914	7910
D0807	DIODE, 1N914	1520914	7910
D0835	DIODE, CD1541	1521541	14655
D0836	DIODE, CD1541	1521541	14655
D0837	DIODE, 1N914	1520914	7910
D0838	DIODE, 1N751A	1520751	75042
D0845	DIODE, 1N753A	1520753	1295
D0850	DIODE, 1N914	1520914	7910
D0851	DIODE, 1N914	1520914	7910
D0852	DIODE, 1N914	1520914	7910
D0853	DIODE, HOT CARRIER	1522835	10597
D0854	DIODE, 1N914	1520914	7910
D0855	DIODE, HOT CARRIER	1522835	10597
D0857	DIODE, 1N757	1520757	1295
D0862	DIODE, 1N704A	1520704	1295
D1400	TO		
D1403	DIODE, HOT CARRIER	1522835	10597
D1445	DIODE, 1N914	1520914	7910
D1446	DIODE, 1N914	1520914	7910
D1450	DIODE, 1N914	1520914	7910
D1451	DIODE, 1N914	1520914	7910
D1485	DIODE, 1N914	1520914	7910
D1486	DIODE, 1N914	1520914	7910
D1490	DIODE, 1N914	1520914	7910
D1600	DIODE, 1N748	1520748	1295
D1601	DIODE, 1N748	1520748	1295
D1622	DIODE, 1N914	1520914	7910
D1626	DIODE, 1N914	1520914	7910
D1632	MATCHED DIODES, 1N914	1530003	10597
D1670	DIODE, 1N914	1520914	7910
D1671	DIODE, 1N914	1520914	7910
D1675	DIODE, 1N914	1520914	7910
D1676	DIODE, 1N914	1520914	7910
D1680	DIODE, 1N914	1520914	7910
D1685	DIODE, 1N914	1520914	7910
D1690	DIODE, 1N753A	1520753	1295
D1695	DIODE, 1N753A	1520753	1295
F0100	FUSE, 1AMP 3AG	1590029	71400
I0100	LAMP, #2187	1500019	71744
I1485	LAMP, #2187	1500019	71744
J0100	BINDING POST, BLACK	3550536	10597
J0101	BINDING POST, WHITE	3550535	10597
J0240	CONNECTOR, BNC	1310047	91836
J0490	CONNECTOR, BNC	1310047	91836
J0500	CONNECTOR, BNC	1310047	91836
J0800	CONNECTOR, BNC	1310047	91836
J0840	CONNECTOR, BNC	1310047	91836
J1600	CONNECTOR, BNC	1310047	91836
K0494	RELAY, SPST REED 5 VOLT	2600328	10597
K0510	RELAY, SPST REED 5 VOLT	2600328	10597
K1490	RELAY, SPST REED 5 VOLT	2600328	10597
L0140	BEAD, FERRITE G303	1140034	1121
L0440	BEAD, FERRITE G303	1140034	1121
L0460	BEAD, FERRITE G303	1140034	1121
L0461	BEAD, FERRITE G303	1140034	1121
L0465	BEAD, FERRITE G303	1140034	1121
L0800	BEAD, FERRITE G303	1140034	1121
L0835	BEAD, FERRITE G303	1140034	1121
L1407	BEAD, FERRITE G303	1140034	1121
L1625	TO		
L1696	BEAD, FERRITE G303	1140034	1121
Q0100	INTEGRATED CIRCUIT, UA723C	1580042	1295
Q0105	TRANSISTOR, 2N4918	1564918	4713
Q0120	INTEGRATED CIRCUIT, UA723C	1580042	1295
Q0125	TRANSISTOR, MJE3055	1563055	5277
Q0130	INTEGRATED CIRCUIT, UA723C	1580042	1295
Q0135	TRANSISTOR, 2N4921	1564921	4713
Q0140	TRANSISTOR, 2N2219	1562219	1295
Q0145	TRANSISTOR, MJE3740	1563740	4713
Q0150	TRANSISTOR, 2N4121	1564121	7263
Q0155	TRANSISTOR, 2N4121	1564121	7263
Q0160	TRANSISTOR, 2N2219	1562219	1295
Q0165	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0170	TRANSISTOR, 2N2905	1562905	1295
Q0175	TRANSISTOR, 2N4918	1564918	4713
Q0180	TRANSISTOR, 2N2219	1562219	1295
Q0235	TRANSISTOR, 2N2905	1562905	1295
Q0240	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0265	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0270	TRANSISTOR, 2N5245	1565245	1295
Q0275	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0280	TRANSISTOR, 2N5462	1565462	4713
Q0300	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0310	TRANSISTOR, 2N2219	1562219	1295
Q0345	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0350	TRANSISTOR, 2N4250	1564250	7263
Q0355	TRANSISTOR, UC2138	1562138	61637
Q0360	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0365	TRANSISTOR, 2N2219	1562219	1295
Q0370	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0375	TRANSISTOR, 2N4121	1564121	7263
Q0380	TRANSISTOR, MPS3646	1563646	4713
Q0385	TRANSISTOR, MPS3646	1563646	4713
Q0390	TRANSISTOR, 2N4121	1564121	7263
Q0400	TRANSISTOR, UC2138	1562138	61637
Q0405	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0410	TRANSISTOR, UC400	1560400	17856
Q0415	TRANSISTOR, UC2138	1562138	61637
Q0420	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0425	TRANSISTOR, 2N4416	1564416	4713
Q0430	TRANSISTOR, 2N2905	1562905	1295
Q0435	TRANSISTOR, DF991	1560991	10597
Q0440	TRANSISTORS, MATCHED TIS87	1570087	10597
Q0445	TRANSISTOR, MATCHED 2N3866	1573866	10597
Q0460	TRANSISTORS, MATCHED TIS87	1570087	10597
Q0465	TRANSISTOR, 2N2219	1562219	1295
Q0470	TRANSISTOR, 2N4258	1564258	7263
Q0475	TRANSISTOR, 2N4258	1564258	7263
Q0490	TRANSISTOR, MPS3563	1563563	4713
Q0495	TRANSISTOR, 2N4121	1564121	7263
Q0500	INTEGRATED CIRCUIT, MC1035	1581035	4713
Q0510	INTEGRATED CIRCUIT, MC1004	1581004	4713
Q0515	TRANSISTOR, 2N2219	1562219	1295
Q0522	TRANSISTOR, 2N4258	1564258	7263
Q0525	TRANSISTOR, 2N4258	1564258	7263
Q0720	INTEGRATED CIRCUIT, CA3046	1580043	1295
Q0722	TRANSISTOR, 2N4258	1564258	7263
Q0725	TRANSISTOR, MPS3563	1563563	4713
Q0730	TRANSISTOR, 2N2905	1562905	1295
Q0735	TRANSISTOR, 2N2219	1562219	1295
Q0740	TRANSISTOR, MPS3563	1563563	4713
Q0745	TRANSISTOR, 2N4258	1564258	7263
Q0750	TRANSISTOR, MPS3563	1563563	4713
Q0755	TRANSISTOR, 2N4258	1564258	7263
Q0760	INTEGRATED CIRCUIT, CA3046	1580043	1295
Q0780	TRANSISTOR, 2N4258	1564258	7263
Q0785	TRANSISTOR, MPS3646	1563646	4713
Q0790	TRANSISTOR, 2N2905	1562905	1295
Q0795	TRANSISTOR, 2N2219	1562219	1295
Q0800	TRANSISTOR, TIS87	1560087	1295
Q0805	TRANSISTOR, 2N4121	1564121	7263
Q0810	TRANSISTOR, 2N2219	1562219	1295
Q0815	TRANSISTOR, 2N2905	1562905	1295
Q0830	TRANSISTORS, MATCHED 2N4258	1574258	10597
Q0835	TRANSISTOR, TIS87	1560087	1295
Q0840	TRANSISTOR, MPS3563	1563563	4713
Q0845	TRANSISTOR, 2N4258	1564258	7263
Q0850	TRANSISTOR, TIS87	1560087	1295
Q0860	TRANSISTOR, TIS87	1560087	1295
Q1420	TRANSISTOR, UC2138	1562138	61637
Q1425	TRANSISTOR, 2N5245	1565245	1295
Q1430	TRANSISTOR, 2N4250	1564250	7263
Q1435	TRANSISTOR, 2N4250	1564250	7263
Q1440	TRANSISTOR, MPS6543	1566543	4713
Q1445	TRANSISTOR, TIS87	1560087	1295
Q1450	TRANSISTOR, 2N4121	1564121	7263
Q1455	TRANSISTOR, TIS87	1560087	1295
Q1460	TRANSISTOR, 2N4121	1564121	7263
Q1470	TRANSISTOR, MPS3646	1563646	4713
Q1475	TRANSISTOR, 2N4121	1564121	7263
Q1480	TRANSISTOR, TIS87	1560087	1295
Q1485	TRANSISTOR, 2N2219	1562219	1295
Q1600	OPERATIONAL AMPLIFIER, CA3030A	1580008	2735
Q1615	INTEGRATED CIRCUIT, CA3046	1580043	1295
Q1620	TRANSISTOR, 2N2484	1562484	7263
Q1625	TRANSISTOR, 2N4121	1564121	7263
Q1630	TRANSISTOR, MATCHED 2N4121	1574121	10597
Q1640	INTEGRATED CIRCUIT, UA796C	1580796	1295
Q1650	INTEGRATED CIRCUIT, CA3046	1580043	1295
Q1662	TRANSISTOR, 2N4258	1564258	7263
Q1665	TRANSISTOR, MPS3563	1563563	4713
Q1670	TRANSISTOR, 2N4258	1564258	7263
Q1675	TRANSISTOR, MPS3563	1563563	4713
Q1680	TRANSISTOR, MPS3563	1563563	4713
Q1685	TRANSISTOR, 2N4258	1564258	7263
Q1690	TRANSISTOR, MPS3563	1563563	4713
Q1695	TRANSISTOR, 2N4258	1564258	7263
R0100	RESISTOR, 750 OHM 1/4W 1% METAL FILM	3137500	7115
R0101	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0102	RESISTOR, 2210 OHM 1/4W 1% METAL FILM	3132211	7115
R0103	RESISTOR, 56 OHM 1/4W 5% CARBON	3070560	1121
R0105	RESISTOR, 2.2 OHM 1/2W 5% CARBON	3210220	1121
R0120	RESISTOR, 220Ω OHM 1/4W 5% CARBON	3070222	1121
R0125	RESISTOR, 2.5 OHM WIREWOUND	3080005	75042
R0126	RESISTOR, 787Ω OHM 1/4W 1% METAL FILM	3137871	7115
R0127	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0128	RESISTOR, 301Ω OHM 1/4W 1% METAL FILM	3133011	7115
R0130	RESISTOR, 162Ω OHM 1/4W 5% CARBON	3070162	1121
R0135	RESISTOR, 2.5 OHM WIREWOUND	3080005	75042
R0136	RESISTOR, 332Ω OHM 1/4W 1% METAL FILM	3133321	7115
R0137	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0138	RESISTOR, 301Ω OHM 1/4W 1% METAL FILM	3133011	7115
R0140	RESISTOR, 36Ω OHM 1/4W 5% CARBON	3070361	1121
R0141	RESISTOR, 560Ω OHM 1/4W 5% CARBON	3070562	1121
R0142	RESISTOR, 100Ω OHM 1/4W 5% CARBON	3070102	1121
R0143	RESISTOR, 15K OHM 1/4W 5% CARBON	3070153	1121
R0145	RESISTOR, 10Ω OHM 1/4W 5% CARBON	3070101	1121
R0146	RESISTOR, 2.5 OHM WIREWOUND	3080005	75042
R0150	RESISTOR, 499Ω OHM 1/4W 1% METAL FILM	3134991	7115
R0151	RESISTOR, 560Ω OHM 1/4W 5% CARBON	3070562	1121
R0152	RESISTOR, 36500 OHM 1/4W 1% METAL FILM	3133652	7115
R0155	RESISTOR, 560Ω OHM 1/4W 5% CARBON	3070562	1121
R0156	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0157	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0158	RESISTOR, 12720 OHM 1/4W 1% METAL FILM	3131272	7115
R0161	RESISTOR, 13K OHM 1/4W 5% CARBON	3070133	1121
R0162	RESISTOR, 34800 OHM 1/4W 1% METAL FILM	3133482	7115
R0165	RESISTOR, 15000 OHM 1/4W 1% METAL FILM	3131502	7115
R0166	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0167	RESISTOR, 22100 OHM 1/4W 1% METAL FILM	3132212	7115
R0168	RESISTOR, 8250 OHM 1/4W 1% METAL FILM	3138251	7115
R0170	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0171	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R0175	RESISTOR, 2.5 OHM WIREWOUND	3080005	75042
R0235	RESISTOR, 620 OHM 1/4W 5% CARBON	3070621	1121

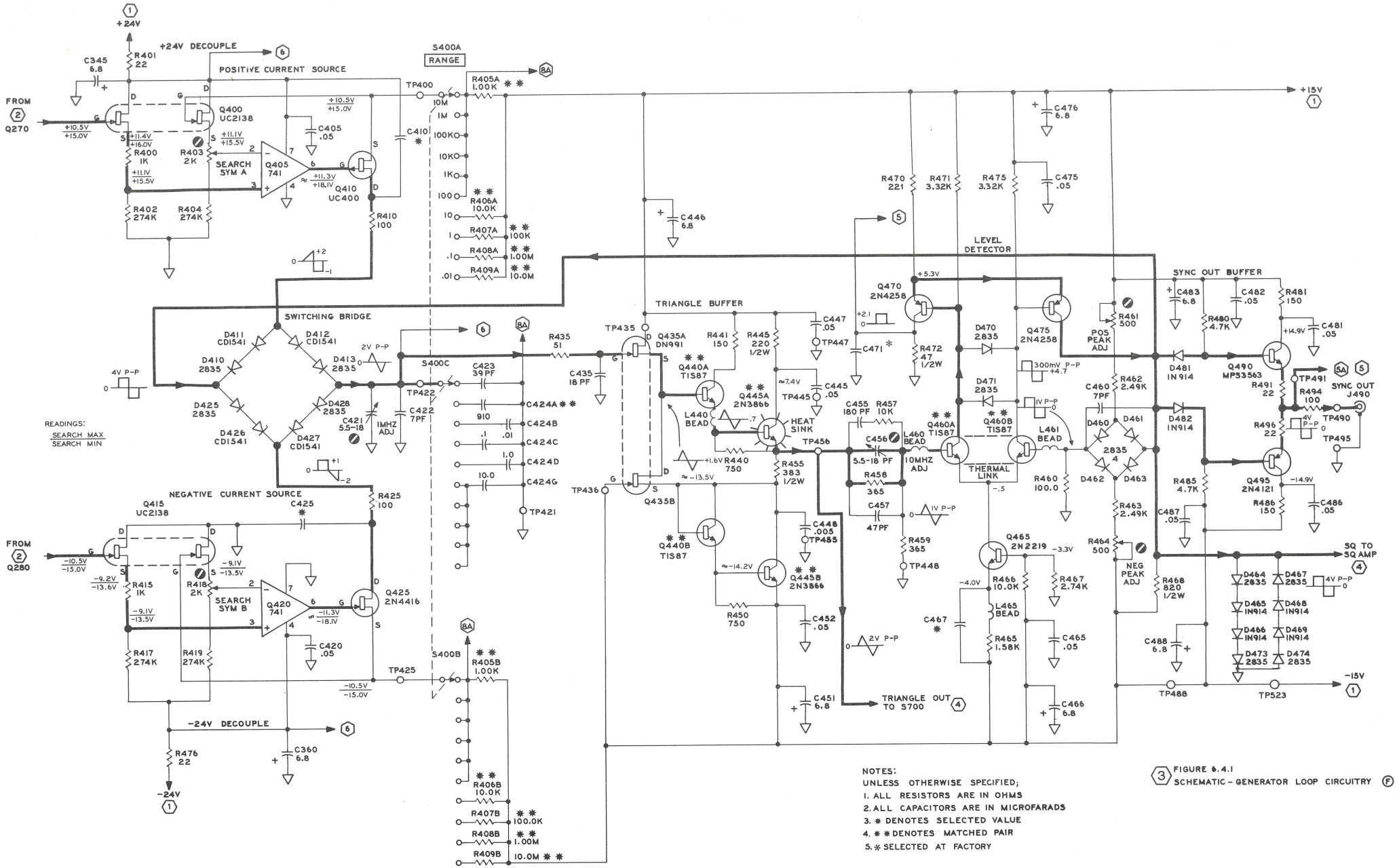
PART	DESCRIPTION	EXACT NO	MFG
R0236	RESISTOR, 110K OHM 1/4W 1% METAL FILM	3131103	7115
R0237	RESISTOR, 5100 OHM 1/4W 5% CARBON	3070512	1121
R0238	POTENTIOMETER, 20K OHM PC TRIM	3110131	78488
R0240	RESISTOR, 49900 OHM 1/4W 1% METAL FILM	3134992	7115
R0241	RESISTOR, 124K OHM 1/4W 1% METAL FILM	3131243	7115
R0242	RESISTOR, 10000K OHM 1/4W 5% CARBON	3070106	1121
R0243	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0245	RESISTOR, 22K OHM 1/4W 5% CARBON	3070223	1121
R0246	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0247	RESISTOR, 124K OHM 1/4W 1% METAL FILM	3131243	7115
R0248	RESISTOR, 100K OHM 1/4W 1% METAL FILM	3131003	7115
R0249	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0265	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0266	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0267	RESISTOR, SELECTED VALUE		
R0268	POTENTIOMETER, 20K/20K DUAL	3110336	10582
R0269	RESISTOR, 1000 OHM MATCHED PAIR	3121001	10597
R0275	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0276	RESISTOR, 1000 OHM MATCHED PAIR	3121001	10597
R0278	RESISTOR, SELECTED VALUE		
R0301	RESISTOR, 5100 OHM 1/4W 5% CARBON	3070512	1121
R0304	RESISTOR, 75000 OHM 1/4W 1% METAL FILM	3137502	7115
R0306	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0310	RESISTOR, 1300 OHM 1/4W 5% CARBON	3070132	1121
R0311	RESISTOR, 620 OHM 1/4W 5% CARBON	3070621	1121
R0312	CONCENTRIC SWITCH & POTENTIOMETER	2600313	71450
R0313	RESISTOR, SELECTED VALUE		
R0314	TO		
R0325	RESISTOR, 100 OHM 1/8W 1% METAL FILM	3181000	7115
R0345	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0346	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0350	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0355	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0357	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0358	POTENTIOMETER, 2K OHM PC TRIM	3110130	78488
R0359	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0360	RESISTOR, 499 OHM 1/4W 1% METAL FILM	3134990	7115
R0361	RESISTOR, 4990 OHM 1/4W 1% METAL FILM	3134991	7115
R0362	RESISTOR, 49900 OHM 1/4W 1% METAL FILM	3134992	7115
R0363	RESISTOR, 499K OHM 1/4W 1% METAL FILM	3134993	7115
R0364	RESISTOR, 5000K OHM 1/2W 1% DEP. CARBON	3095004	75042
R0365	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0370	POTENTIOMETER, 10K OHM MIN	3110327	71450
R0371	RESISTOR, 100K OHM 1/4W 1% METAL FILM	3131003	7115
R0372	RESISTOR, 7500 OHM 1/4W 5% CARBON	3070752	1121
R0373	RESISTOR, 8060 OHM 1/4W 1% METAL FILM	3138061	7115
R0374	RESISTOR, 3320 OHM 1/4W 1% METAL FILM	3133321	7115
R0375	RESISTOR, 150 OHM 1/4W 5% CARBON	3070151	1121
R0380	RESISTOR, 150 OHM 1/4W 5% CARBON	3070151	1121
R0385	RESISTOR, 4,7 OHM 1/4W 5% CARBON	3070047	1121
R0386	RESISTOR, 4700 OHM 1/4W 5% CARBON	3070472	1121
R0390	RESISTOR, 2,0 OHM 1/2W 5% CARBON	3010020	1121
R0392	RESISTOR, 4700 OHM 1/4W 5% CARBON	3070472	1121
R0393	RESISTOR, 4,7 OHM 1/4W 5% CARBON	3070047	1121
R0400	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0401	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0402	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0403	POTENTIOMETER, 2K OHM PC TRIM	3110130	78488
R0404	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0405	RESISTOR, 1000 OHM MATCHED PAIR	3121001	10597
R0406	RESISTOR, 10000 OHM MATCHED PAIR	3121002	10597
R0407	RESISTOR, 100K OHM MATCHED PAIR	3121003	10597
R0408	RESISTOR, 1000K OHM MATCHED PAIR	3121004	10597
R0409	RESISTOR, 10000K OHM MATCHED PAIR	3121005	10597
R0410	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0415	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0417	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0418	POTENTIOMETER, 2K OHM PC TRIM	3110130	78488
R0419	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0425	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0430	RESISTOR, 3900 OHM 1/4W 5% CARBON	3070392	1121
R0431	RESISTOR, 270 OHM 1/4W 5% CARBON	3070271	1121
R0432	RESISTOR, 4700 OHM 1/4W 5% CARBON	3070472	1121
R0433	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0435	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0440	RESISTOR, 750 OHM 1/4W 5% CARBON	3070751	1121
R0441	RESISTOR, 150 OHM 1/4W 5% CARBON	3070151	1121
R0445	RESISTOR, 220 OHM 1/2W 5% CARBON	3010221	1121
R0450	RESISTOR, 750 OHM 1/4W 5% CARBON	3070751	1121
R0455	RESISTOR, 383 OHM 1/2W 1% METAL FILM	3103830	7115
R0457	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R0458	RESISTOR, 365 OHM 1/4W 1% METAL FILM	3133650	7115
R0459	RESISTOR, 365 OHM 1/4W 1% METAL FILM	3133650	7115
R0460	RESISTOR, 100 OHM 1/4W 1% METAL FILM	3131000	7115
R0461	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0462	RESISTOR, 2490 OHM 1/4W 1% METAL FILM	3132491	7115
R0463	RESISTOR, 2490 OHM 1/4W 1% METAL FILM	3132491	7115
R0464	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0465	RESISTOR, 1580 OHM 1/4W 1% METAL FILM	3131581	7115
R0466	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0467	RESISTOR, 2740 OHM 1/4W 1% METAL FILM	3132741	7115
R0468	RESISTOR, 820 OHM 1/2W 5% CARBON	3010821	1121
R0470	RESISTOR, 221 OHM 1/2W 1% METAL FILM	3102210	7115
R0471	RESISTOR, 3320 OHM 1/4W 1% METAL FILM	3133321	7115
R0472	RESISTOR, 47 OHM 1/2W 5% CARBON	3010470	1121
R0475	RESISTOR, 3320 OHM 1/4W 1% METAL FILM	3133321	7115
R0476	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0480	RESISTOR, 4700 OHM 1/4W 5% CARBON	3070472	1121
R0481	RESISTOR, 150 OHM 1/4W 5% CARBON	3070151	1121
R0485	RESISTOR, 4700 OHM 1/4W 5% CARBON	3070472	1121
R0486	RESISTOR, 150 OHM 1/4W 5% CARBON	3070151	1121
R0491	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0494	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0496	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0497	RESISTOR, 470 OHM 1/4W 5% CARBON	3070471	1121
R0500	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R0501	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R0502	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0503	POTENTIOMETER, 1 K OHM REVERSE LOG	3110332	12697
R0504	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0505	RESISTOR, 4700 OHM 1/4W 5% CARBON	3070472	1121
R0506	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0507	RESISTOR, 499 OHM 1/4W 1% METAL FILM	3134990	7115
R0508	RESISTOR, 523 OHM 1/4W 1% METAL FILM	3135230	7115
R0509	RESISTOR, 1500 OHM 1/4W 5% CARBON	3070152	1121
R0510	RESISTOR, 475 OHM 1/4W 1% METAL FILM	3134750	7115
R0511	RESISTOR, 383 OHM 1/4W 1% METAL FILM	3133830	7115
R0512	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0513	RESISTOR, 365 OHM 1/4W 1% METAL FILM	3133650	7115
R0514	RESISTOR, 383 OHM 1/4W 1% METAL FILM	3133830	7115
R0515	RESISTOR, 475 OHM 1/4W 1% METAL FILM	3134750	7115
R0516	RESISTOR, 8200 OHM 1/4W 5% CARBON	3070822	1121
R0517	RESISTOR, 2000 OHM 1/4W 5% CARBON	3070202	1121
R0518	RESISTOR, 6800 OHM 1/4W 5% CARBON	3070682	1121
R0519	RESISTOR, 39 OHM 1/4W 5% CARBON	3070390	1121
R0520	RESISTOR, 249 OHM 1/2W 1% METAL FILM	3102490	7115
R0521	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R0522	RESISTOR, 470K OHM 1/4W 5% CARBON	3070474	1121
R0525	RESISTOR, 820 OHM 1/4W 5% CARBON	3070821	1121
R0526	RESISTOR, 2000 OHM 1/4W 5% CARBON	3070202	1121
R0604	RESISTOR, 49,9 OHM 1/4W 1% METAL FILM	3130499	7115
R0605	RESISTOR, 200 OHM 1/4W 1% METAL FILM	3132000	7115
R0606	RESISTOR, 100 OHM 1/4W 1% METAL FILM	3131000	7115
R0607	RESISTOR, 100 OHM 1/4W 1% METAL FILM	3131000	7115
R0608	RESISTOR, 47 OHM 1/4W 5% CARBON	3070470	1121
R0615	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0616	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0617	RESISTOR, 75,0 OHM 1/4W 1% METAL FILM	3130750	7115
R0618	RESISTOR, 63,4 OHM 1/4W 1% METAL FILM	3130634	7115
R0619	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0620	RESISTOR, 232 OHM 1/4W 1% METAL FILM	3132320	7115
R0621	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0623	RESISTOR, 30100 OHM 1/4W 1% METAL FILM	3133012	7115
R0624	POTENTIOMETER, 100 OHM TRIM	3110141	71450
R0627	RESISTOR, 28,7 OHM 1/8W 1% METAL FILM	3180287	7115
R0628	RESISTOR, 30100 OHM 1/4W 1% METAL FILM	3133012	7115
R0631	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0636	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0637	RESISTOR, 28,7 OHM 1/8W 1% METAL FILM	3180287	7115
R0645	RESISTOR, 11300 OHM 1/4W 1% METAL FILM	3131132	7115
R0646	RESISTOR, 11300 OHM 1/4W 1% METAL FILM	3131132	7115
R0647	RESISTOR, 6810 OHM 1/4W 1% METAL FILM	3136811	7115
R0648	RESISTOR, 6810 OHM 1/4W 1% METAL FILM	3136811	7115
R0700	RESISTOR, 14300 OHM 1/4W 1% METAL FILM	3131432	7115
R0701	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0702	RESISTOR, 15 OHM 1/4W 5% CARBON	3070150	1121
R0703	RESISTOR, 20000 OHM 1/4W 1% METAL FILM	3132002	7115
R0704	RESISTOR, 20000 OHM 1/4W 1% METAL FILM	3132002	7115
R0705	RESISTOR, 1500 OHM 1/4W 1% METAL FILM	3131501	7115
R0706	RESISTOR, 200K OHM 1/4W 1% METAL FILM	3132003	7115
R0707	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0708	POTENTIOMETER, 250 OHM	3110145	71450
R0709	RESISTOR, 1370 OHM 1/4W 1% METAL FILM	3131371	7115
R0710	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R0711	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0712	RESISTOR, 330 OHM 1/4W 5% CARBON	3070331	1121
R0715	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0720	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0721	RESISTOR, 120 OHM 1/4W 5% CARBON	3070121	1121
R0722	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0725	RESISTOR, 9310 OHM 1/4W 1% METAL FILM	3139311	7115
R0726	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0727	RESISTOR, 160 OHM 1/4W 5% CARBON	3070161	1121
R0728	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0730	RESISTOR, 4020 OHM 1/4W 1% METAL FILM	3134021	7115
R0731	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0735	RESISTOR, 5490 OHM 1/4W 1% METAL FILM	3135491	7115
R0736	RESISTOR, 4020 OHM 1/4W 1% METAL FILM	3134021	7115
R0737	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0740	RESISTOR, 27 OHM 1/4W 5% CARBON	3070270	1121
R0741	RESISTOR, 47 OHM 1/4W 5% CARBON	3070470	1121
R0745	RESISTOR, 27 OHM 1/4W 5% CARBON	3070270	1121
R0746	RESISTOR, 47 OHM 1/4W 5% CARBON	3070470	1121
R0750	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0755	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0757	RESISTOR, 301 OHM 1/4W 1% METAL FILM	3133010	7115
R0758	RESISTOR, 301 OHM 1/4W 1% METAL FILM	3133010	7115
R0759	RESISTOR, 4,7 OHM 1/4W 5% CARBON	3070047	1121
R0760	RESISTOR, 24900 OHM 1/4W 1% METAL FILM	3132492	7115
R0761	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0762	RESISTOR, 47 OHM 1/4W 5% CARBON	3070470	1121
R0763	RESISTOR, 40200 OHM 1/4W 1% METAL FILM	3134022	7115
R0764	RESISTOR, 40200 OHM 1/4W 1% METAL FILM	3134022	7115
R0765	RESISTOR, 1500 OHM 1/4W 1% METAL FILM	3131501	7115
R0766	RESISTOR, 200K OHM 1/4W 1% METAL FILM	3132003	7115
R0767	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0768	RESISTOR, 2700 OHM 1/4W 5% CARBON	3070272	1121
R0770	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R0775	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0780	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0781	RESISTOR, 47 OHM 1/4W 5% CARBON	3070470	1121
R0782	RESISTOR, 499 OHM 1/4W 1% METAL FILM	3134990	7115
R0785	RESISTOR, 6190 OHM 1/4W 1% METAL FILM	3136191	7115
R0786	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0787	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R0788	RESISTOR, 499 OHM 1/4W 1% METAL FILM	3134990	7115
R0790	RESISTOR, 806 OHM 1/4W 1% METAL FILM	3138060	7115
R0791	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0795	RESISTOR, 6190 OHM 1/4W 1% METAL FILM	3136191	7115
R0796	RESISTOR, 806 OHM 1/4W 1% METAL FILM	3138060	7115
R0797	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0798	RESISTOR, SELECTED VALUE		
R0800	RESISTOR, 27 OHM 1/4W 5% CARBON	3070270	1121
R0801	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R0805	RESISTOR, 27 OHM 1/4W 5% CARBON	3070270	1121
R0810	RESISTOR, 15 OHM 1/4W 5% CARBON	3070150	1121

PART	DESCRIPTION	EXACT NO	MFG
R0811	RESISTOR, 15 OHM 1/2W 5% CARBON	3010150	1121
R0812	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0815	RESISTOR, 15 OHM 1/4W 5% CARBON	3070150	1121
R0816	RESISTOR, 15 OHM 1/2W 5% CARBON	3010150	1121
R0817	RESISTOR, 1500 OHM 1/4W 1% METAL FILM	3131501	7115
R0820	TO		
R0822	RESISTOR, 150 OHM 1/2W 1% METAL FILM	3101500	7115
R0823	RESISTOR, 26.1 OHM 1/4W 1% METAL FILM	3130261	7115
R0824	RESISTOR, 26.1 OHM 1/4W 1% METAL FILM	3130261	7115
R0825	RESISTOR, 34.8 OHM 1/4W 1% METAL FILM	3130348	7115
R0826	RESISTOR, 41.2 OHM 1/2W 1% METAL FILM	3100412	7115
R0827	RESISTOR, 41.2 OHM 1/2W 1% METAL FILM	3100412	7115
R0828	RESISTOR, 10.0 OHM 1/8W 1% METAL FILM	3180100	7115
R0829	RESISTOR, 46.4 OHM 1/2W 1% METAL FILM	3100464	7115
R0830	RESISTOR, 46.4 OHM 1/2W 1% METAL FILM	3100464	7115
R0831	RESISTOR, 3.16 OHM 1/8W 1% DEP. CARBON	3193160	7115
R0832	RESISTOR, 15 OHM 1/4W 5% CARBON	3070150	1121
R0833	RESISTOR, 1500 OHM 1/4W 5% CARBON	3070152	1121
R0834	RESISTOR, 576 OHM 1/4W 1% METAL FILM	3135760	7115
R0835	RESISTOR, 1500 OHM 1/4W 5% CARBON	3070152	1121
R0836	POTENTIOMETER, 5K OHM TRIM	3110149	71450
R0837	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0838	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0839	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0840	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0841	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0842	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0843	RESISTOR, 1500 OHM 1/4W 5% CARBON	3070152	1121
R0844	RESISTOR, 15 OHM 1/4W 5% CARBON	3070150	1121
R0845	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0846	RESISTOR, 374 OHM 1/4W 1% METAL FILM	3133740	7115
R0847	RESISTOR, 127 OHM 1/4W 1% METAL FILM	3131270	7115
R0848	RESISTOR, 750 OHM 1/4W 1% METAL FILM	3137500	7115
R0849	POTENTIOMETER, 100 OHM TRIM	3110141	71450
R0850	RESISTOR, 274 OHM 1/4W 1% METAL FILM	3132740	7115
R0851	RESISTOR, 2740 OHM 1/4W 1% METAL FILM	3132741	7115
R0852	RESISTOR, 866 OHM 1/4W 1% METAL FILM	3138660	7115
R0853	POTENTIOMETER, 10K OHM MIN	3110327	71450
R0854	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0855	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0856	RESISTOR, 1270 OHM 1/4W 1% METAL FILM	3131271	7115
R0857	RESISTOR, 680 OHM 1/2W 5% CARBON	3010681	1121
R0858	RESISTOR, 2370 OHM 1/2W 1% METAL FILM	3102371	7115
R0859	RESISTOR, 15 OHM 1/4W 5% CARBON	3070150	1121
R0860	RESISTOR, 475 OHM 1/2W 1% METAL FILM	3104750	7115
R0861	RESISTOR, 2490 OHM 1/4W 1% METAL FILM	3132491	7115
R0862	SWITCH, ROTARY	2600344	10597
R0863	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0864	RESISTOR, 1470 OHM 1/4W 1% METAL FILM	3131471	7115
R1401	RESISTOR, 1821 OHM 1/4W 1% METAL FILM	3131821	7115
R1402	RESISTOR, 15000 OHM 1/4W 1% METAL FILM	3131502	7115
R1403	RESISTOR, 15000 OHM 1/4W 1% METAL FILM	3131502	7115
R1408	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R1420	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R1421	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R1422	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R1423	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R1424	RESISTOR, 324K OHM 1/4W 1% METAL FILM	3133243	7115
R1425	RESISTOR, 2000 OHM 1/4W 1% METAL FILM	3132001	7115
R1426	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R1427	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R1430	RESISTOR, 12K OHM 1/4W 5% CARBON	3070123	1121
R1440	RESISTOR, 15K OHM 1/4W 5% CARBON	3070153	1121
R1441	RESISTOR, 160 OHM 1/4W 5% CARBON	3070161	1121
R1442	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R1445	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R1446	RESISTOR, 100K OHM 1/4W 5% CARBON	3070104	1121
R1450	RESISTOR, 620 OHM 1/4W 5% CARBON	3070621	1121
R1451	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R1452	RESISTOR, 27 OHM 1/4W 5% CARBON	3070270	1121
R1455	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R1456	RESISTOR, 20 OHM 1/4W 5% CARBON	3070200	1121
R1460	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R1470	RESISTOR, 2700 OHM 1/4W 5% CARBON	3070272	1121
R1471	RESISTOR, 1800 OHM 1/4W 5% CARBON	3070182	1121
R1472	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R1475	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R1480	RESISTOR, 680 OHM 1/4W 5% CARBON	3070681	1121
R1481	RESISTOR, 12K OHM 1/4W 5% CARBON	3070103	1121
R1485	RESISTOR, 100 OHM 1/2W 5% CARBON	3010101	1121
R1500	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R1501	RESISTOR, 20K OHM 1/4W 5% CARBON	3070203	1121
R1502	RESISTOR, 82K OHM 1/4W 5% CARBON	3070823	1121
R1503	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R1600	POTENTIOMETER, 10K OHM	3110334	12697
R1601	RESISTOR, 30100 OHM 1/4W 1% METAL FILM	3133012	7115
R1602	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R1603	POTENTIOMETER, 2K OHM PC TRIM	3110130	78488
R1604	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R1605	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R1606	RESISTOR, 16500 OHM 1/4W 1% METAL FILM	3131652	7115
R1607	POTENTIOMETER, 5K OHM TRIM	3110149	71450
R1608	RESISTOR, 16500 OHM 1/4W 1% METAL FILM	3131652	7115
R1609	RESISTOR, 332 OHM 1/4W 1% METAL FILM	3133320	7115
R1610	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R1611	RESISTOR, 820 OHM 1/4W 5% CARBON	3070821	1121
R1612	RESISTOR, 820 OHM 1/4W 5% CARBON	3070821	1121
R1613	RESISTOR, 2000 OHM 1/4W 1% METAL FILM	3132001	7115
R1614	RESISTOR, 2000 OHM 1/4W 1% METAL FILM	3132001	7115
R1615	POTENTIOMETER, 100 OHM TRIM	3110141	71450
R1616	RESISTOR, 634 OHM 1/4W 1% METAL FILM	3136340	7115
R1617	RESISTOR, 332 OHM 1/4W 1% METAL FILM	3133320	7115
R1618	RESISTOR, 332 OHM 1/4W 1% METAL FILM	3133320	7115
R1619	RESISTOR, 909 OHM 1/4W 1% METAL FILM	3139090	7115
R1620	RESISTOR, 2800 OHM 1/4W 1% METAL FILM	3132801	7115
R1621	RESISTOR, 499 OHM 1/4W 1% METAL FILM	3134990	7115
R1622	RESISTOR, 2490 OHM 1/4W 1% METAL FILM	3132491	7115

PART	DESCRIPTION	EXACT NO	MFG
R1623	RESISTOR, 12100 OHM 1/4W 1% METAL FILM	3131212	7115
R1624	RESISTOR, 14200 OHM 1/4W 1% METAL FILM	3131402	7115
R1625	RESISTOR, 499 OHM 1/4W 1% METAL FILM	3134990	7115
R1626	RESISTOR, 2490 OHM 1/4W 1% METAL FILM	3132491	7115
R1627	RESISTOR, 12100 OHM 1/4W 1% METAL FILM	3131212	7115
R1630	RESISTOR, 1240 OHM 1/4W 1% METAL FILM	3131241	7115
R1631	RESISTOR, 1240 OHM 1/4W 1% METAL FILM	3131241	7115
R1632	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R1633	RESISTOR, 24.3 OHM 1/8W 1% METAL FILM	3180243	7115
R1634	RESISTOR, 24.3 OHM 1/8W 1% METAL FILM	3180243	7115
R1635	RESISTOR, 931 OHM 1/4W 1% METAL FILM	3139310	7115
R1640	POTENTIOMETER, 100 OHM TRIM	3110141	71450
R1641	RESISTOR, 2320 OHM 1/4W 1% METAL FILM	3132321	7115
R1642	RESISTOR, 49.9 OHM 1/4W 1% METAL FILM	3130499	7115
R1643	RESISTOR, 1650 OHM 1/4W 1% METAL FILM	3131651	7115
R1644	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R1650	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R1651	RESISTOR, 20000 OHM 1/4W 1% METAL FILM	3132002	7115
R1652	RESISTOR, 20000 OHM 1/4W 1% METAL FILM	3132002	7115
R1653	RESISTOR, 15 OHM 1/4W 5% CARBON	3070150	1121
R1654	RESISTOR, 14300 OHM 1/4W 1% METAL FILM	3131432	7115
R1655	RESISTOR, 1050 OHM 1/4W 1% METAL FILM	3131051	7115
R1656	RESISTOR, 3310 OHM 1/4W 1% METAL FILM	3133011	7115
R1657	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R1660	RESISTOR, 18 OHM 1/4W 5% CARBON	3070180	1121
R1662	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R1663	RESISTOR, 9310 OHM 1/4W 1% METAL FILM	3139311	7115
R1665	RESISTOR, 220 OHM 1/4W 5% CARBON	3070221	1121
R1667	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R1670	RESISTOR, 4020 OHM 1/4W 1% METAL FILM	3134021	7115
R1671	RESISTOR, 5490 OHM 1/4W 1% METAL FILM	3135491	7115
R1672	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R1673	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R1676	RESISTOR, 4020 OHM 1/4W 1% METAL FILM	3134021	7115
R1677	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R1680	RESISTOR, 27 OHM 1/4W 5% CARBON	3070270	1121
R1681	RESISTOR, 47 OHM 1/4W 5% CARBON	3070470	1121
R1685	RESISTOR, 27 OHM 1/4W 5% CARBON	3070270	1121
R1690	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R1695	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R1696	RESISTOR, 4.7 OHM 1/4W 5% CARBON	3070047	1121
R1697	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R1700	RESISTOR, 4990 OHM 1/4W 1% METAL FILM	3134991	7115
R1701	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R1703	RESISTOR, 300 OHM 1/4W 5% CARBON	3070301	1121
S0100	SWITCH, TOGGLE SPDT	2600103	100005
S0101	SWITCH, SLIDE	2600319	10597
S0265	SWITCH, PUSH BUTTON	2600347	10597
S0310	CONCENTRIC SWITCH & POTENTIOMETER	2600313	71450
S0400	SWITCH, ROTARY	2600346	10597
S0500	SWITCH, PUSH BUTTON	2600347	10597
S0510	SWITCH, PUSH BUTTON	2600347	10597
S0515	SWITCH, PUSH BUTTON	2600347	10597
S0700	SWITCH, ROTARY	2600344	10597
S0705	SWITCH, PUSH BUTTON	2600353	10597
S0710	SWITCH, PUSH BUTTON	2600353	10597
S0800	SWITCH, PUSH BUTTON	2600353	10597
S0810	SWITCH, PUSH BUTTON	2600353	10597
S0820	SWITCH, PUSH BUTTON	2600353	10597
S0837	SWITCH, PUSH BUTTON	2600353	10597
S1500	SWITCH, PUSH BUTTON	2600347	10597
S1500	SWITCH, PUSH BUTTON	2600347	10597
S1501	SWITCH, PUSH BUTTON	2600353	10597
S1501	SWITCH, PUSH BUTTON	2600347	10597
S1600	SWITCH, PUSH BUTTON	2600353	10597
T0100	TRANSFORMER, POWER	1200042	10597
R1628	RESISTOR, SELECTED VALUE		

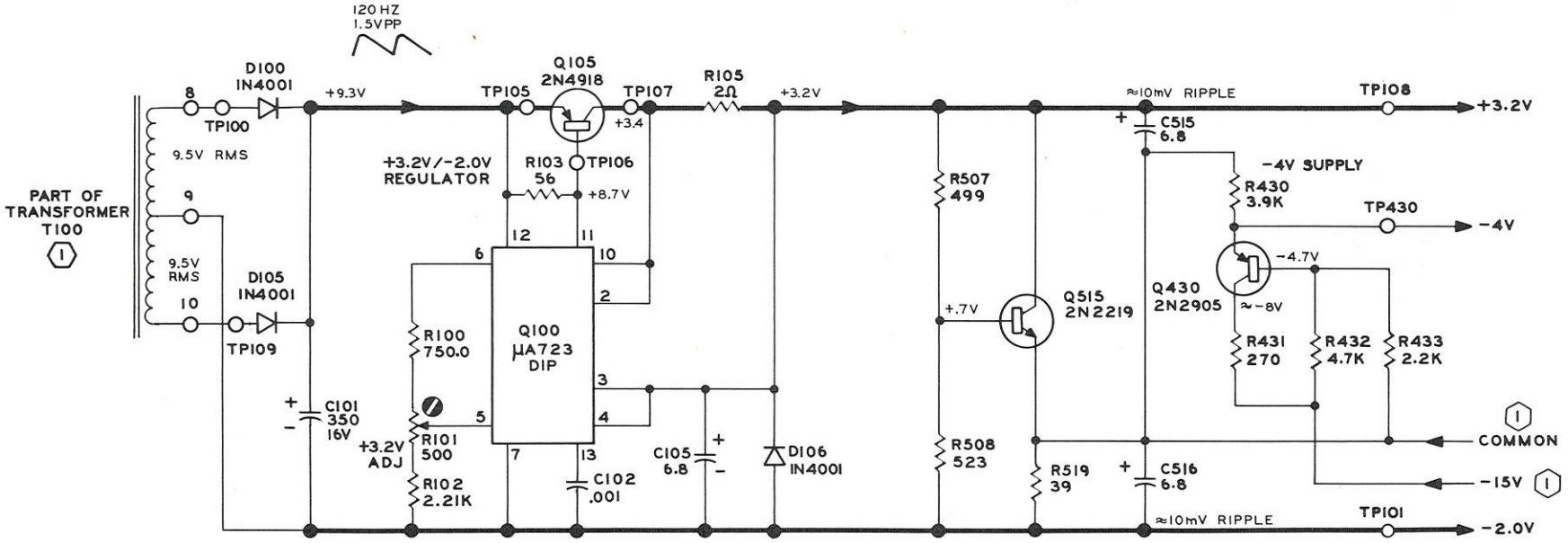
SECTION 6

PARTS OVERLAY AND SCHEMATICS



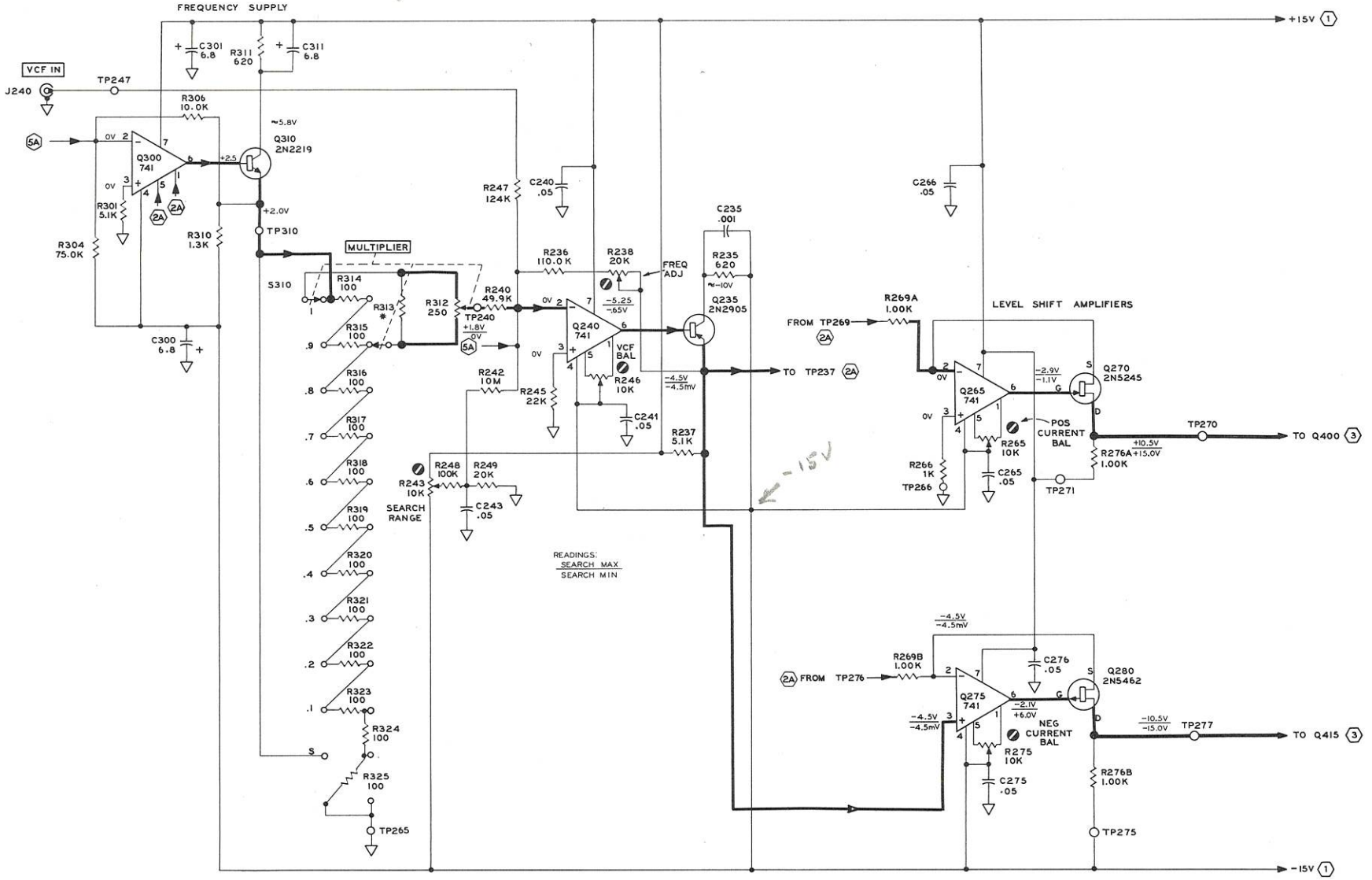
NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE IN OHMS
2. ALL CAPACITORS ARE IN MICROFARADS
3. * DENOTES SELECTED VALUE
4. * * DENOTES MATCHED PAIR
5. * SELECTED AT FACTORY

FIGURE 6.4.1
SCHEMATIC - GENERATOR LOOP CIRCUITRY (F)



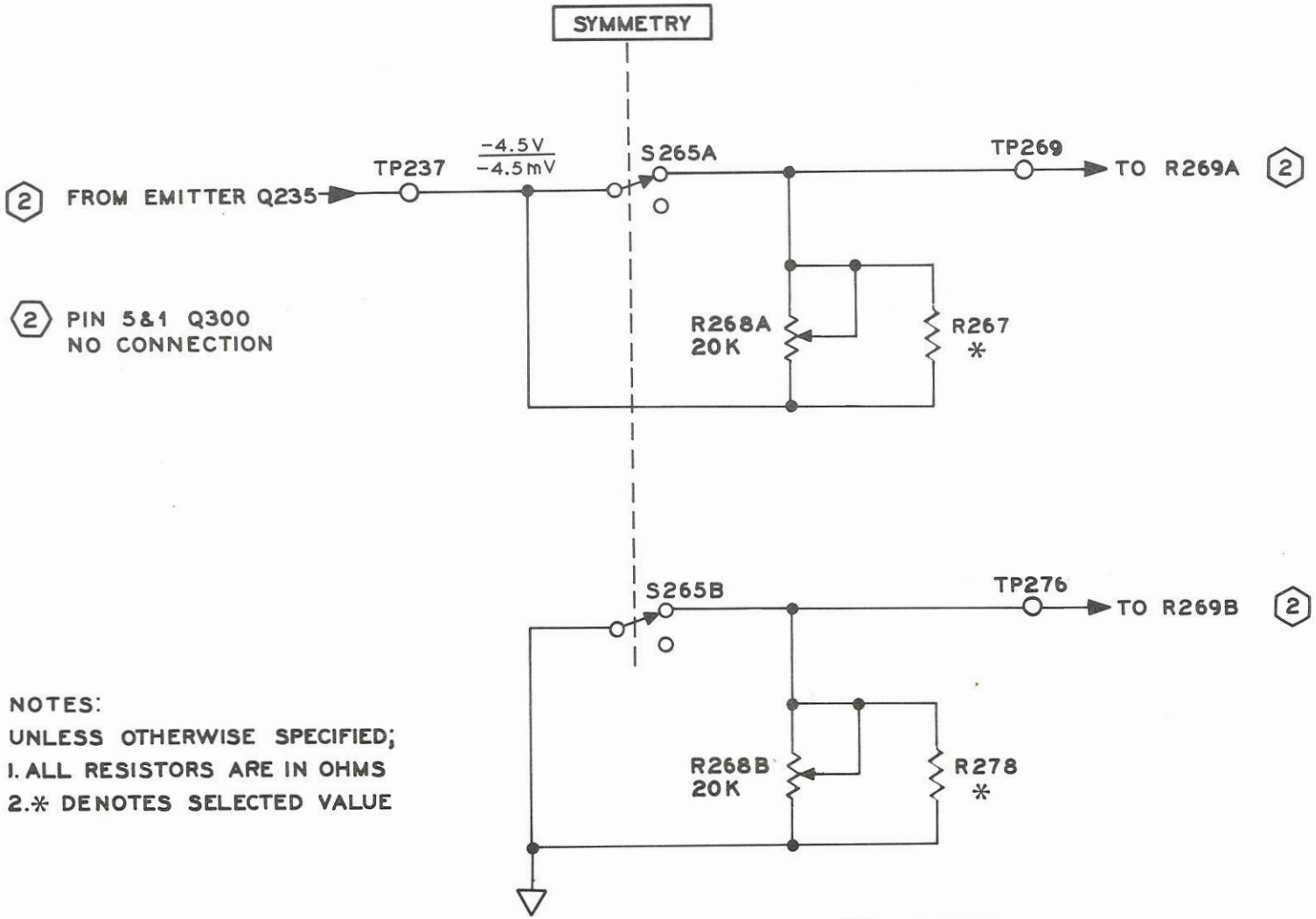
NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE IN OHMS
2. ALL CAPACITORS ARE IN MICROFARADS

1A FIGURE 6.2.2
SCHEMATIC - LOGIC POWER SUPPLY Ⓑ Ⓒ Ⓔ Ⓕ



NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE IN OHMS
2. ALL CAPACITORS ARE IN MICROFARADS
3. * DENOTES SELECTED VALUE

FIGURE 6.3.1
SCHEMATIC-FREQUENCY CONTROL CIRCUIT
(A)



NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE IN OHMS
2. * DENOTES SELECTED VALUE

2A FIGURE 6.3.2
SCHEMATIC-VARIABLE SYMMETRY (A)(F)(D)

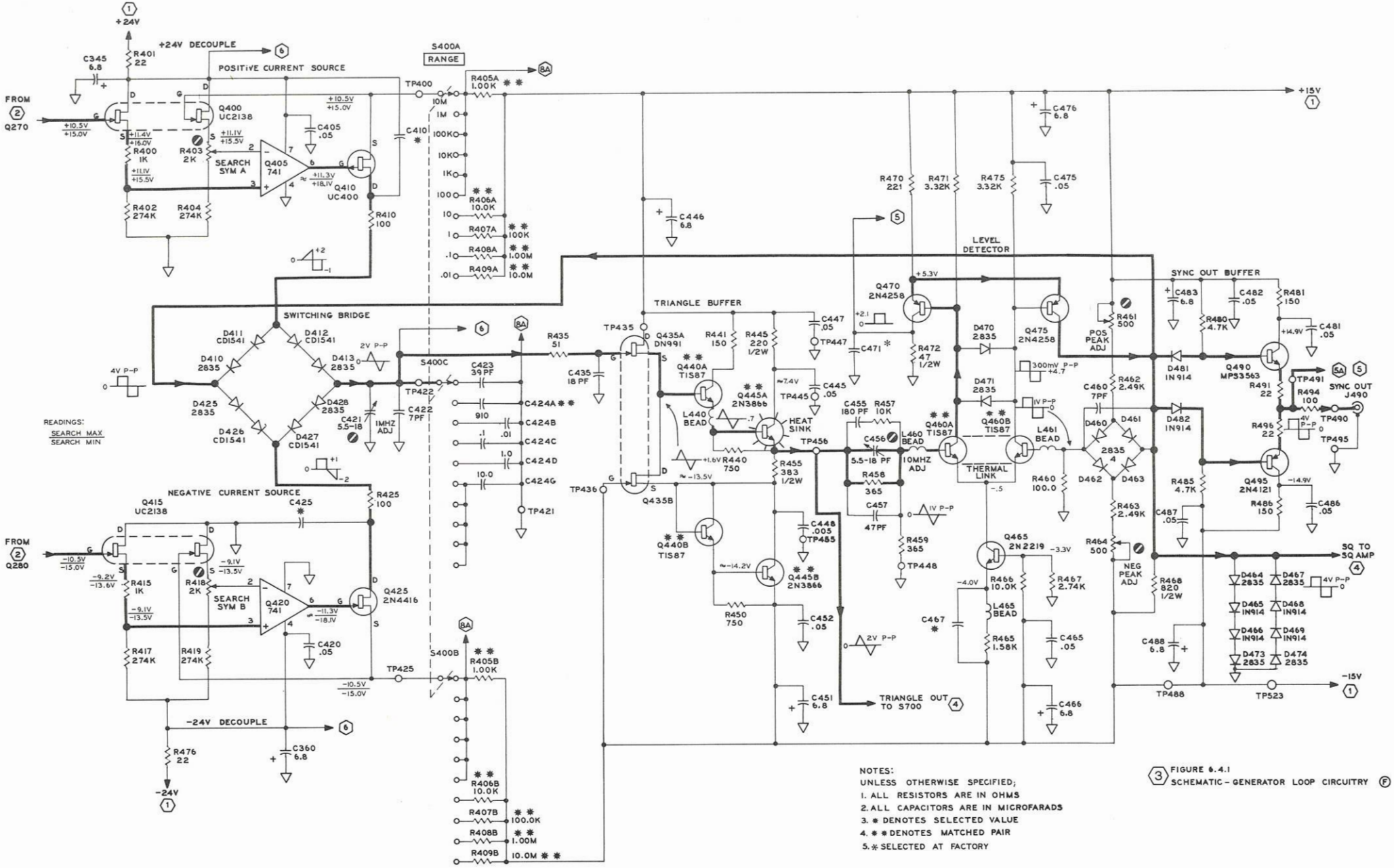
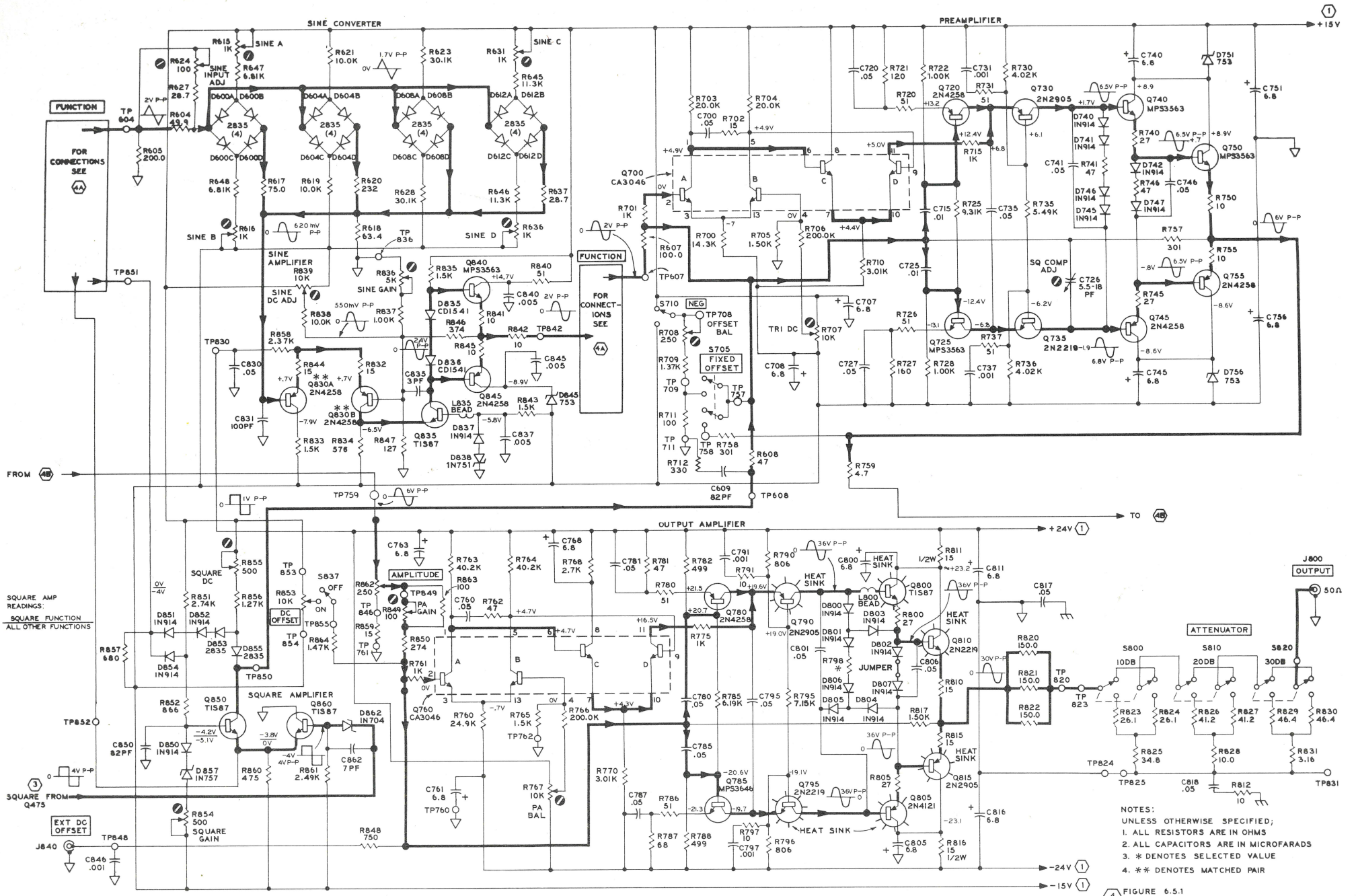
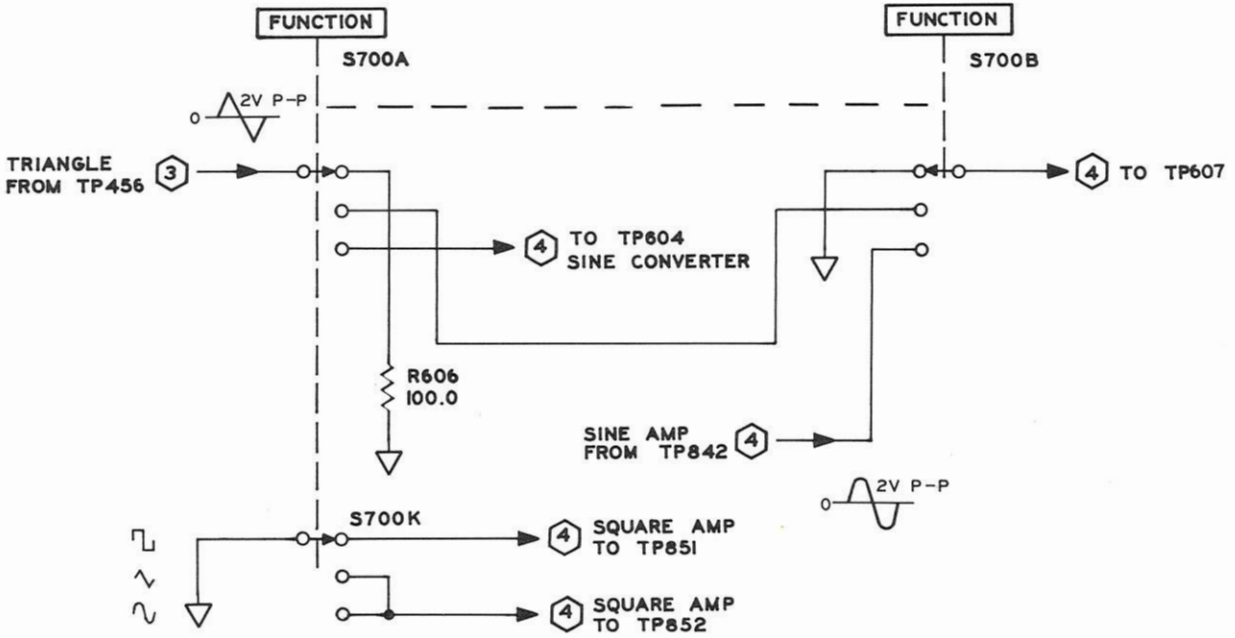


FIGURE 6.4.1
SCHEMATIC - GENERATOR LOOP CIRCUITRY (F)


SINE CONVERTER
PREAMPLIFIER
OUTPUT AMPLIFIER
SINE A
SINE B
SINE C
SINE D
SINE INPUT ADJ
SINE AMPLIFIER
SINE DC ADJ
SINE GAIN
FUNCTION
FOR CONNECTIONS SEE 4A
TP 604
TP851
TP830
TP836
TP842
TP608
TP759
TP850
TP852
TP848
TP760
TP762
TP761
TP849
TP846
TP853
TP854
TP855
TP708 OFFSET BAL
S705 FIXED OFFSET
S710 NEG
TRI DC
SQ COMP ADJ
FROM 4B
TO 4B
+15V
+24V
-24V
-15V
SQUARE AMP READINGS:
SQUARE FUNCTION
ALL OTHER FUNCTIONS
SQUARE DC
SQUARE GAIN
SQUARE FROM Q475
EXT DC OFFSET
DC OFFSET
AMPLITUDE
PA GAIN
PA BAL
HEAT SINK
JUMPER
ATTENUATOR
J800 OUTPUT
50Ω
S800 10DB
S810 20DB
S820 30DB
TP 820
TP 823
TP824
TP825
TP831
C609 82PF
C850 82PF
C846 .001
C818 .05
R848 750
R759 4.7
R608 47
R712 330
R711 100
R709 1.37K
R708 250
R607 100.0
R701 1K
R700 14.3K
R703 20.0K
R704 20.0K
R702 15
R705 1.50K
R706 200.0K
R710 3.01K
R715 1K
R757 301
R758 301
R854 500 SQUARE GAIN
R855 500 SQUARE DC
R853 10K DC OFFSET
R862 250 AMPLITUDE
R863 100
R849 100 PA GAIN
R767 10K PA BAL
R770 3.01K
R797 10
R796 806
R816 15 1/2W
R811 15 1/2W
R817 1.50K
R810 15
R815 15
R805 27
R800 27
R790 806
R791 10
R775 1K
R785 6.19K
R795 7.15K
R780 51
R782 499
R781 47
R787 68
R788 499
R786 51
R760 24.9K
R761 1K
R762 47
R763 40.2K
R764 40.2K
R765 1.5K
R766 200.0K
R768 2.7K
R850 274
R851 2.74K
R852 866
R856 1.27K
R857 680
R858 2.37K
R859 15
R860 475
R861 2.49K
R864 1.47K
R831 3.16
R830 46.4
R829 46.4
R828 10.0
R827 41.2
R826 41.2
R825 34.8
R824 26.1
R823 26.1
R822 150.0
R821 150.0
R820 150.0
R755 10
R750 10
R737 51
R736 4.02K
R735 5.49K
R730 4.02K
R731 51
R722 1.00K
R721 120
R720 51
R727 160
R728 1.00K
R726 51
R725 9.31K
R722 1.00K
R741 47
R746 47
R745 27
R740 27
R748 10
C811 6.8
C817 .05
C816 6.8
C805 6.8
C797 .001
C795 .05
C785 .05
C780 .05
C801 .05
C806 .05
C791 .001
C768 6.8
C763 6.8
C761 6.8
C787 .05
C707 6.8
C708 6.8
C727 .05
C737 .001
C715 .01
C725 .01
C735 .05
C741 .05
C746 .05
C751 6.8
C756 6.8
C745 6.8
C726 5.5-18 PF
C720 .05
C731 .001
C700 .05
C760 .05
C840 .005
C845 .005
C837 .005
C835 3PF
C831 100PF
C830 .05
C844 15
C832 15
C847 127
C833 1.5K
C834 576
C839 10
C841 10
C842 10
C843 1.5K
C836 5K
C838 10.0K
C839 1.00K
Q700 CA3046
Q760 CA3046
Q840 MPS3563
Q845 2N4258
Q830A 2N4258
Q830B 2N4258
Q835 T1587
Q850 T1587
Q860 T1587
Q780 2N4258
Q790 2N2905
Q795 2N2219
Q785 MPS3646
Q800 T1587
Q810 2N2219
Q815 2N2905
Q805 2N4121
Q720 2N4258
Q730 2N2905
Q740 MPS3563
Q750 MPS3563
Q755 2N4258
Q725 MPS3563
Q735 2N2219
Q745 2N4258
D600A D600B D600C D600D
D604A D604B D604C D604D
D608A D608B D608C D608D
D612A D612B D612C D612D
2835 (4)
D835 CD1541
D836 CD1541
D837 IN914
D838 1N751
D845 753
D851 IN914
D852 IN914
D853 2835
D854 IN914
D855 2835
D857 IN757
D862 IN704
D740 IN914
D741 IN914
D742 IN914
D743 IN914
D744 IN914
D745 IN914
D746 IN914
D747 IN914
D751 753
D756 753
D800 IN914
D801 IN914
D802 IN914
D803 IN914
D804 IN914
D805 IN914
D806 IN914
D807 IN914
L835 BEAD
L800 BEAD
J840
S837 OFF ON
TP 709
TP 711
TP 757
TP 758
TP 761
TP 846
TP 853
TP 854
TP 855
TP 760
TP 762
TP 824
TP 825
TP 831
TP 836
TP 842
TP 850
TP 852
TP 848
TP 759
TP 608
TP 604
TP 851
TP 830
TP 609
TP 607
TP 710
TP 708
TP 757
TP 758
TP 761
TP 846
TP 849
TP 853
TP 854
TP 855
TP 760
TP 762
TP 820
TP 823



NOTE:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE IN OHMS

4A FIGURE 6.5.2
SCHEMATIC-FUNCTION SWITCHING (A) (F)

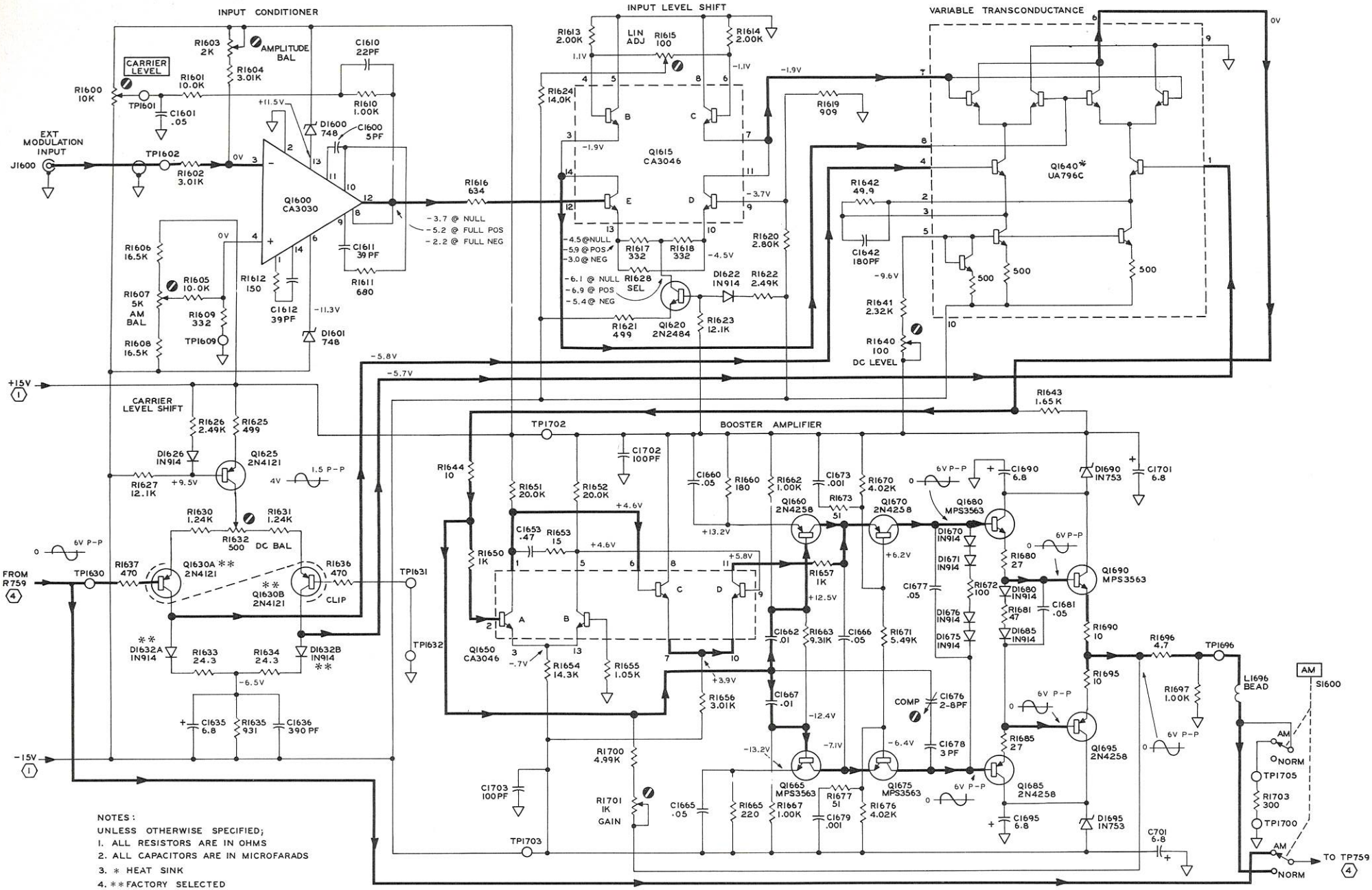
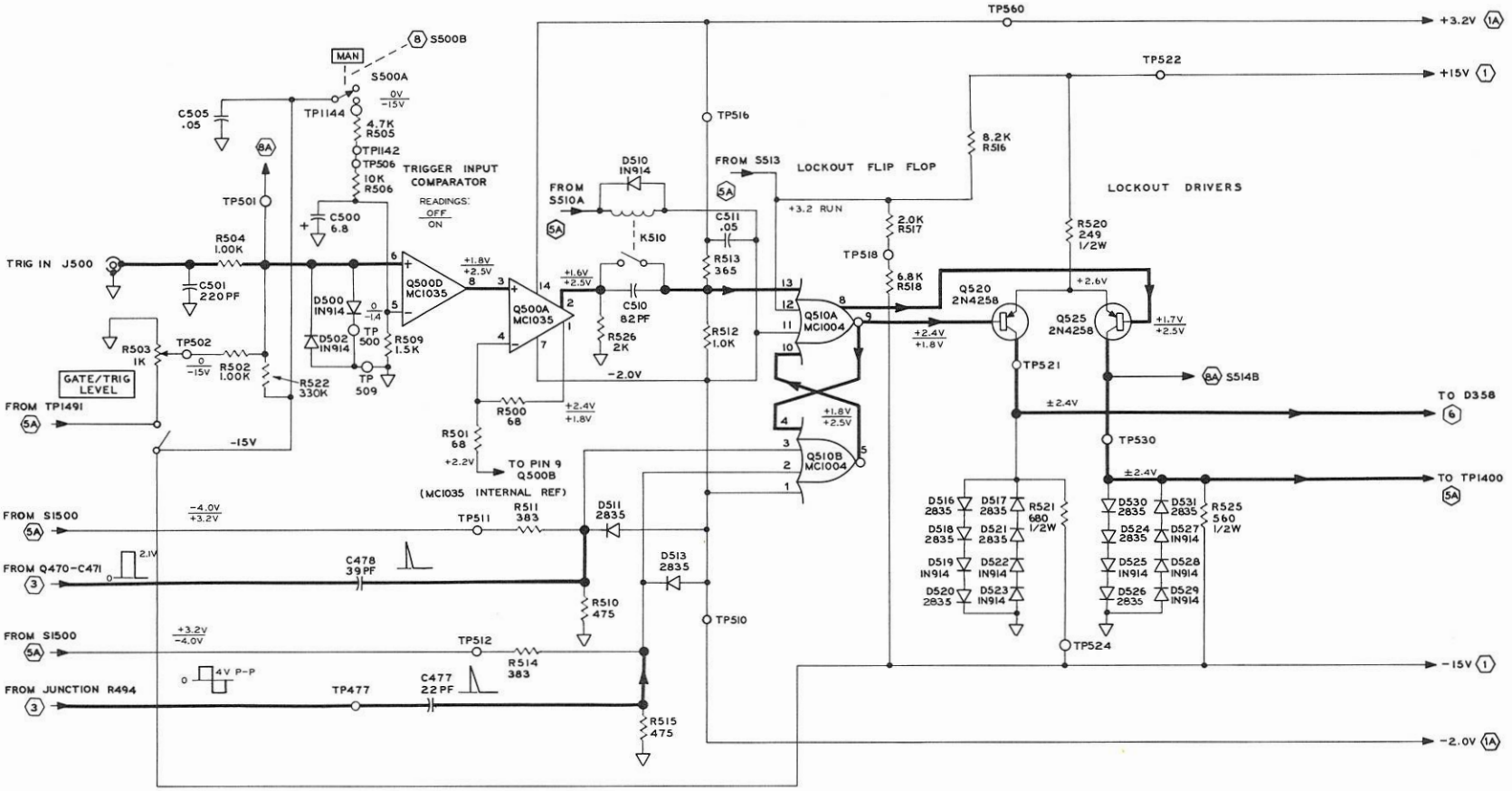
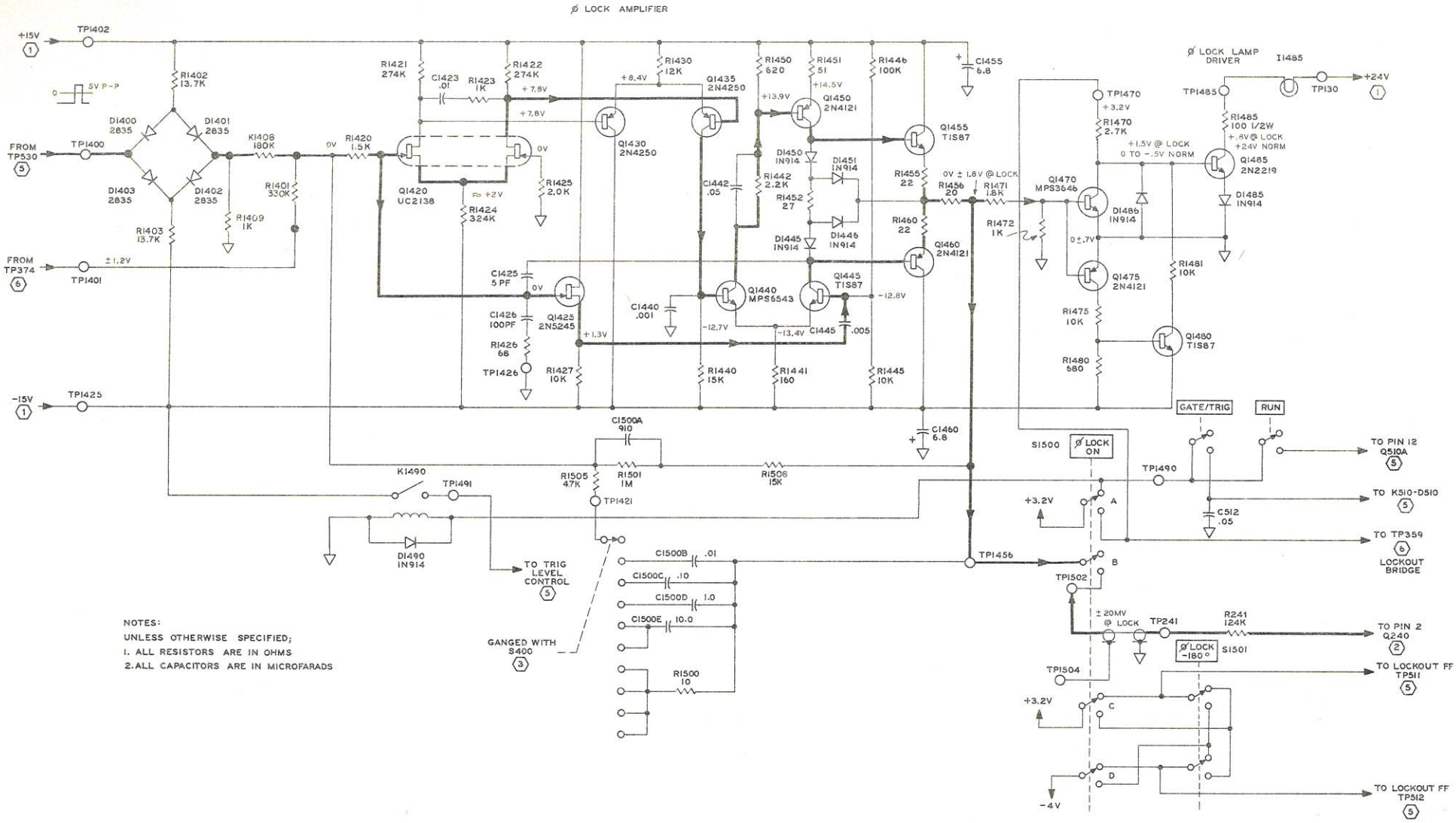


FIGURE 6.5.3
SCHEMATIC-AM CIRCUITRY (F)



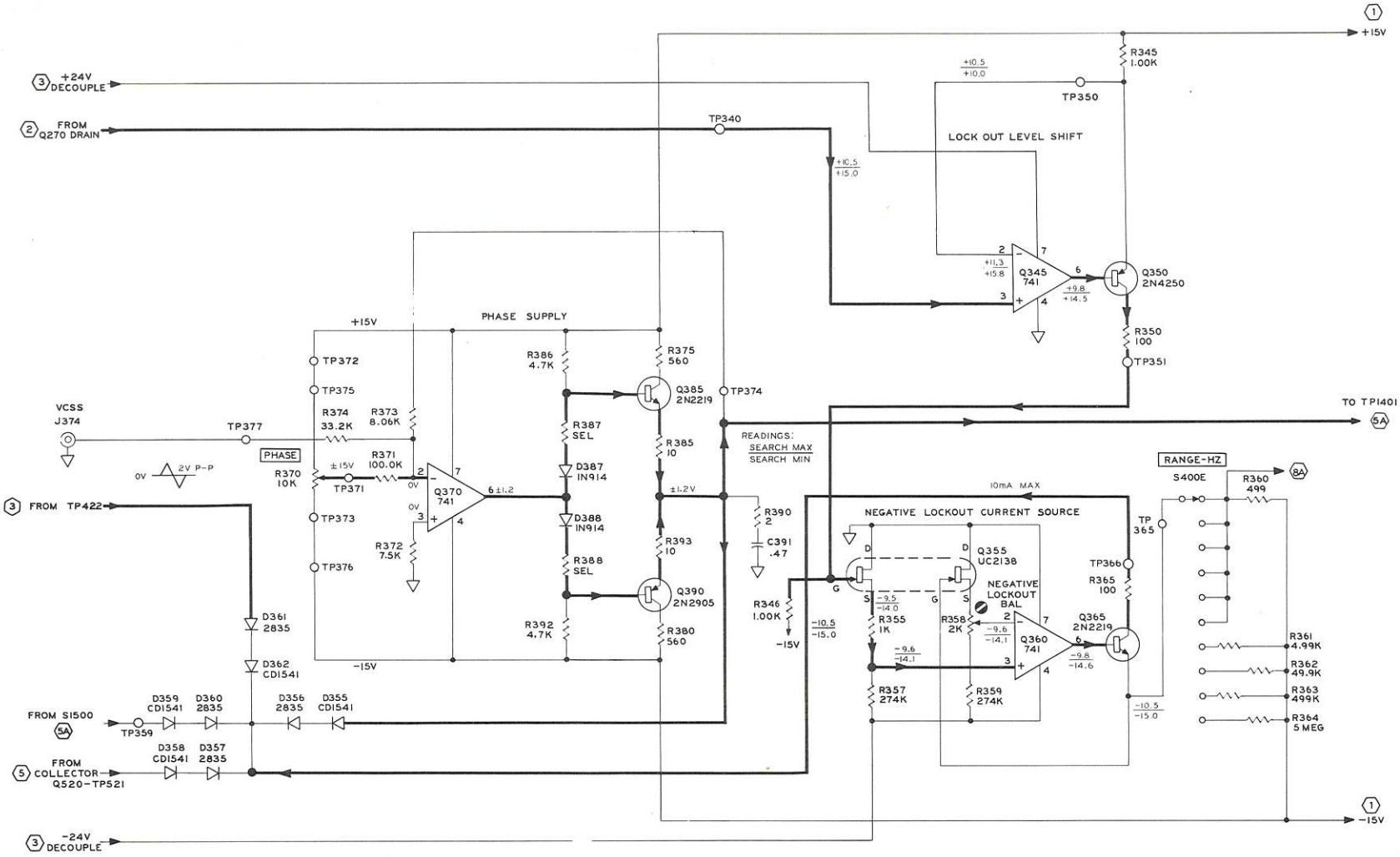
NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE IN OHMS
2. ALL CAPACITORS ARE IN MICROFARADS

(5) FIGURE 6.6.1
SCHEMATIC - LOCKOUT LOGIC (F)
REV (B)



NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE IN OHMS
2. ALL CAPACITORS ARE IN MICROFARADS

5A FIGURE 6.6.2
SCHEMATIC- PHASE LOCK (F)
REV A



NOTES:
UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTORS ARE IN OHMS
2. ALL CAPACITORS ARE IN MICROFARADS

FIGURE 6.7.1
SCHEMATIC-LOCKOUT AMPLIFIER (F)
REV (A)

CONNECTION REFERENCE CHART

ON SCHEMATIC	SCHEMATIC REFERRED TO	CONDITION
(5) S500A	(8)	No other references this model
(5) (6) Tp501	(8A)	No other connections this model

SECTION 7

ADDENDA

At EXACT we continually strive to incorporate latest electronic developments by adding circuit and component improvements to our instrument line as they are developed and tested.

At times, due to printing and shipping requirements, change information is not entered in the main body of the manual. It therefore may contain new change information in the following pages of this section. If change pages do not appear in this section, your manual is correct as printed.

ADDENDA TO PARTS LIST

Model 7056

Change:	R 522 from 470K to 330K	(3070334)
	D 520 from 1N914 to 2835	(1522835)
	D 526 from 1N914 to 2835	(1522835)
	C 1611 from 22pf to 39 pf	(2810531)
	C 1612 from 22pf to 39 pf	(2810531)
	R 1611 from 820Ω to 680Ω	(3070681)
	R 1612 from 820Ω to 150Ω	(3070151)
	R249 from 10K to 20K	(3132002)
	C 768 from 470pf to 4.7µf	(2900023)
	I 100 from #2187 lamp to MLED650	(1520002)
	R 1402 from 15.0K to 13.7K	(3131372)
	R 1403 from 15.0K to 13.7K	(3131372)
	R 1408 from 100Ω to 180K	(3070184)
	R 1501 from 20K to 1M	(3070105)
	R 1401 from 1.82K to 330K	(3070334)
	R 795 from 6.19K to 7.15K	(3137151)
	C 760 from .47µfd to .05 disc	(2830005)
	C 427 from 39pf to 47pf	(2810532)
	Q 160 from 2484 to TIS87	(1560087)
Add:	R 1636 470Ω	(3070471)
	R 1637 470Ω	(3070471)
	C 1600 5pf	(2810501)
	R 131 1K	(3070102)
	R 1409 1K	(3131001)
	R 1505 4.7K	(3070472)
	R 1506 15K	(3070153)
	C 505 .05 disc	(2830005)

Delete: L 1625, L1630, L1631, L1660, L1665, L1685, L 1690, C1704, C1502, R1502, C1408, L1407, R 1503, R801.